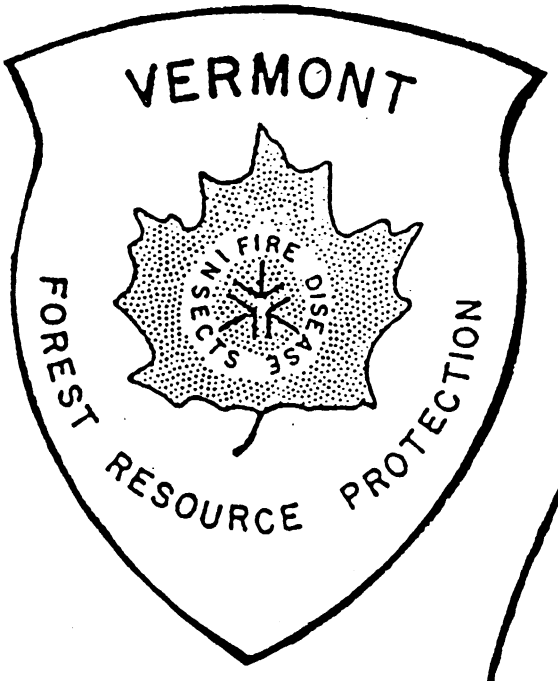
Weeks

FOREST INSECT AND DISEASE CONDITIONS IN VERMONT

CALENDAR YEAR 1990



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DEPARTMENT OF FORESTS,
PARKS, AND RECREATION

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FOREST INSECT AND DISEASE CONDITIONS IN VERMONT CALENDAR YEAR 1990

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AGENCY OF NATURAL RESOURCES

DEPARTMENT OF FORESTS, PARKS AND RECREATION

Division of Forestry

Forest Resource Protection Section

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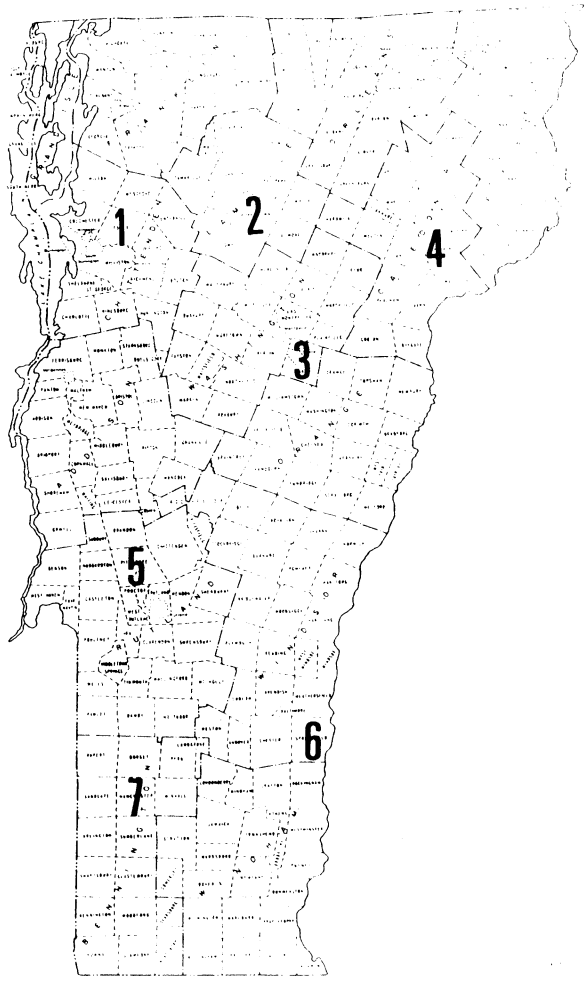

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VERMONT

INSECT AND DISEASE HIGHLIGHTS
1990

Cherry Scallop Shell Moth caused heavy damage to cherries in southern Windham and Bennington Counties.

Forest Tent Caterpillar populations continue to be very low, with no defoliation observed.

Gypsy Moth populations increased with 61,270 acres mapped, compared to 21,510 acres in 1989. An epizootic of the fungus *Entomophaga maimaiga* continued, extending into northern Vermont. Egg mass counts indicate that populations are decreasing for 1991. A cooperative suppression project, using Foray 48B (a Bt product), was conducted on 11,237 acres in Chittenden and Addison Counties.

Maple Leaf Cutter populations increased substantially, with 600 acres of damage mapped in northern Vermont. An additional 3,090 acres of maple browning was mapped in the southern part of the state, caused by maple leaf cutter, anthracnose, maple trumpet skeletonizer, and pear thrips.

Oak Leaf Tier damage was not observed, but moths were caught in pheromone traps.

Saddled Prominent populations continued to increase, with 2,780 acres of defoliation mapped in Bennington and Windham Counties. Feeding activity was noticeable throughout.

Satin Moth caused heavy damage to poplars and willows in widely scattered locations.

Hemlock Looper defoliation was observed on approximately 10 acres of hemlock in Vernon and Brattleboro. Additional damage is expected next year.

Larch Casebearer remains common, with 350 acres of defoliation reported.

Spruce Budworm populations continued at extremely low levels.

Balsam Gall Midge damage increased significantly in 1990 in many locations, but wet spring weather kept much of the damage lower in the crowns than usual.

Balsam Twig Aphid damage was widespread, with 80% of surveyed plantations having heavy damage, compared to 40% in 1989.

Hemlock Woolly Adelgid was introduced to the state on tublings which had been maintained in New Jersey prior to outplanting in Stockbridge. Hemlock tublings on the site are being destroyed during periodic surveys in an attempt to eradicate the insect from the site.

Oystershell Scale populations remain low, but beech dieback, associated with previous infestations, remains noticeable.

VERMONT

1990 FOREST INSECT & DISEASE MANAGEMENT RECOMMENDATIONS

The following recommendations summarize information in this report of particular importance to forest managers. Additional information can be found under specific pests mentioned. Separate summaries are available for sugarbush and Christmas tree managers.

For assistance in identifying pests, diagnosing forest health problems, on-site evaluations, and insect sampling, or to obtain copies of defoliation maps, management recommendations, and additional literature, contact forest resource protection personnel (page i) or your county forester.

Sugar Maple - The general health of maples remains better than usual. Two consecutive years of plentiful rainfall, and limited defoliation, contributed to dense, green leaves.

Several insect and disease problems affected maple foliage in 1991. Pear thrips damage was mapped on 29,760 acres. Most heavily damaged trees refoliated quickly, and the impact on tree health should be negligible. Moderate damage was more common, however. The foliage on many of these trees became increasingly thin as the season progressed, and the impact on tree health may be more significant.

Brown foliage was commonly seen late in the season, caused by anthracnose, maple leaf cutter, maple trumpet skeletonizer, and moderate thrips damage. In all, 5,670 acres of browning were mapped. Because this damage occurred late in the season, the browning is unlikely to have a serious impact on maple health.

Although saddled prominent feeding was common this summer, the population appears to have collapsed in many locations just as numbers were building, probably because of a fungus disease. Residual populations may be high enough in Orange County to cause some defoliation next year. No defoliation by forest tent caterpillar is predicted for the near future.

Birch - Dieback symptoms are improving. Low levels of birch leaf miner and adequate rainfall have reduced the stress on birch.

Beech - Beech bark disease has become more noticeable in the Northeast Kingdom, where 1,690 acres of damage were mapped. If susceptible trees are salvaged, cutting should be done early in the dormant season. This reduces sprouting, which would perpetuate susceptible individuals in the next generation.

Oak - Gypsy moth defoliation was mapped on 61,270 acres. Some stands were defoliated for the second consecutive year. However, populations collapsed over a large area, in part because of a fungus disease. Although some defoliation is expected next year, particularly in Bennington County, areas that have already been defoliated twice are unlikely to receive a third year of defoliation.

VERMONT FOREST HEALTH, INSECT, AND DISEASE PUBLICATIONS: 1990

For copies of the publications listed below, contact the authors, or Forest Resource Protection personnel (page i).

BERGDAHL, D.R., S. HALIK, J. TOMMINEN and H. AKAR. 1990. Frequency of infestation of *Monochamus notatus* and *M. scutellatus* by *Bursaphelenchus xylophilus* in Vermont. Phytophathology (In Press).

HALIK, S. 1990. Survival of *Bursaphelenchus xylophilus* in wood chips in soil and potential for infesting roots of pine seedlings. University of Vermont, M.S. Thesis. 64 pp.

HALIK, S. and D. R. BERGDAHL. 1990. Development of *Bursaphelenchus xylophilus* populations in wood chips with different moisture contents. Journal of Nematology 22:113-118.

PARKER, B. L. and M. SKINNER. 1990. Pear thrips update. Maple Syrup Digest. Vol. 2A(2) June:14.

PARKER, B. L. and M. SKINNER. 1990. VT embarks on significant biological control research for pear thrips management. Maple Syrup Digest Vol. 2A(4) Dec.:35.

PARKER, B. L. and M. SKINNER. 1991. Studying tiny insects in 100-foot tall sugar maples - no problem. Submitted to Bartlett Tree Experts. 2 pp.

REAY, R. S., D. W. BLODGETT, B. S. BURNS, S. J. WEBER and T. FREY. 1990 Management Guide for Deer Wintering Areas in Vermont. VT Dept. of Forests, Parks & Rec. VT Dept. of Fish & Wildlife. 35 pp.

SINCLAIR, W.A., R. J. LULI, A. T. DYER., P. T. MARSHALL, J. A. MATTEONI, C. R. HIBBEN, G. R. STANOSZ, and B. S. BURNS. 1990. Ash yellows: Geographic range and association with decline of white ash. Plant Dis. 74:604-607.

SKINNER, M., B. L. PARKER, and D. R. BERGDAHL. 1990. *Verticillium lecanii*, isolated from larvae of pear thrips, *Taeniothrips inconsequens* in Vermont. Journal of Invertebrate Pathology (In Press).

TOMMINEN, J., S. HALIK, and D. R. BERGDAHL. 1991. Incubation time and temperature effects on life stages of *Bursaphelenchus xylophilus* in wood chips. Journal of Nematology (In Press).

YUILL, J. and B. L. PARKER. 1990. A soil fungus for control of pear thrips. Maple Syrup Digest Vol. 2A(3) Oct.:14.

INTRODUCTION

The information in this report is based largely on aerial surveys to detect defoliation, dieback, and mortality, as well as ground surveys and observations of Forest Resource Protection personnel and other forestry and department staff.

Aerial surveys were flown in early June to mid-July to detect pear thrips damage. One or two additional surveys were flown in mid-July to early September to detect gypsy moth, anthracnose, saddled prominent and maple leaf cutter.

Diagnostic assistance was provided by the University of Vermont, Maine Forest Service, Pennsylvania State University, Connecticut Agricultural Experiment Station, Cornell University, and the U. S. Forest Service.

WEATHER SUMMARY

The 199Ø growing season can be described in one word...wet. Precipitation through the period 1 May - 3Ø September was 35 percent above normal in north-central Vermont monitoring stations.

The winter of 1989-9Ø began with below zero temperatures in December, before much snow had accumulated. Winterburn showed up throughout the state as a result of these conditions.

Spring began all at once in the southern counties, with temperatures in the 9Ø's in late April. Further north, bud development began in late April, but slowed down with cool, wet weather in May.

Seasonal precipitation was very evenly spread throughout the spring and summer months. Our observers in north-central Vermont almost always recorded some precipitation during any seven-day period, and there were no extended periods of dry weather anywhere in the state. There were two very damaging thunderstorms in July that dropped four to five inches of rain in some Northern Vermont locations and washed out many roads. Frequent periods of rainy weather resulted in another year of widespread fungus diseases. Since both 1989 and 199Ø were wet, ground water conditions are well above normal in most locations.

Autumn foliage was bright, but was knocked off early by heavy winds and rain. Killing frosts did not occur until late October in southern areas.

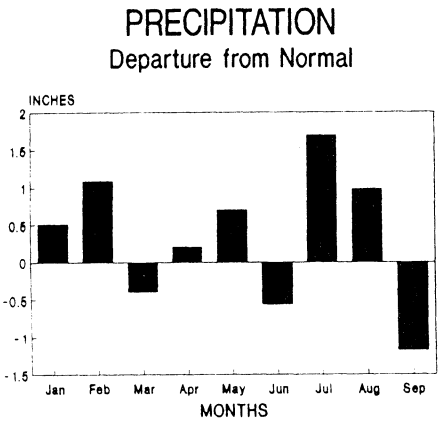
199Ø was a good year for acorn production. Scattered white pines had an unusually heavy crop of cones.

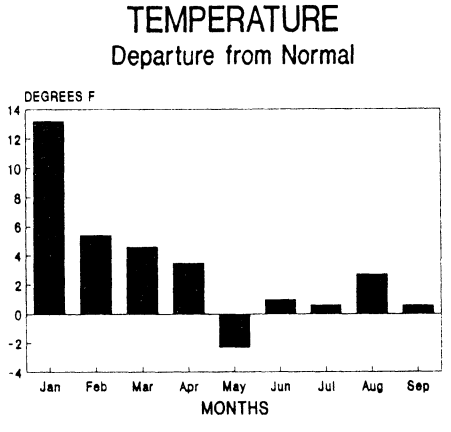
An early winter storm, beginning on November 1Ø, dumped snow accompanied by heavy winds in much of northern Vermont, except for the Connecticut River and Champlain valleys.

Weather for the season is summarized in Figure 1. Phenology observations are summarized in Table 1.

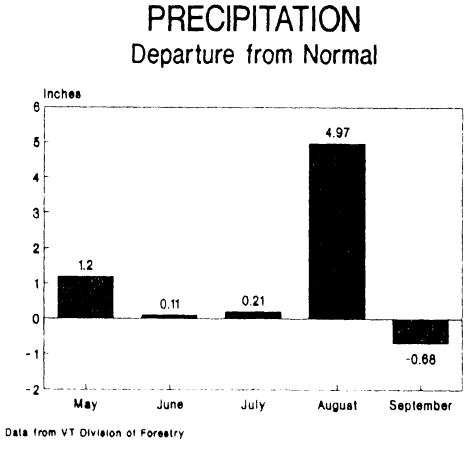
Figure 1. 1990 Weather Summary.

A. Burlington International Airport: Data from NOAA Local Climatological Data: Monthly Summary.





B. North Central Vermont: Data from VT Division of Forestry weather stations in Wolcott, Barre, Randolph, Fairlee and Worcester.



OZONE DAMAGE IN 1991

Provided by Jim O'Brien, U.S. Forest Service

Average ozone concentrations, as measured at Bennington and on Mt. Equinox, were slightly lower in 1990 than in 1989 (34 parts per billion (ppb) in 1990 vs. 35 ppb in 1989). However, the number of hours during which average concentrations were 80 ppb or higher, when sensitive plants are likely to be injured, was higher in 1990 (72 hours in 1990 vs. 40 in 1989).

Surveys of Lye Brook Wilderness, near Manchester, revealed symptoms of ozone injury on black cherry, white ash, white pine, and blackberry (mostly *Rubus vermontanus*) in 1990, as did previous surveys in 1988 and 1989. Injury to white ash was less intensive in 1990 than in 1989, otherwise the degree of injury was about the same in the two years. Symptoms were also noticed on white woodland aster (*Aster divaricatus*), meadowsweet (*Spirea latifolia*), and steeplebush spirea (*S. tomentosa*) in 1990.

In general, ozone caused only light damage to forest plants in Vermont in 1990, as in 1988 and 1989. Nevertheless, injurious concentrations appear to be chronic and probably reduce the growth of sensitive plants. This would lower the ability of sensitive plants to compete with resistant species and thus in the long term reduce their numbers.

Mt. Equinox:

Highest 1 hour average concentration - 97 ppb (102 ppb in 1989)

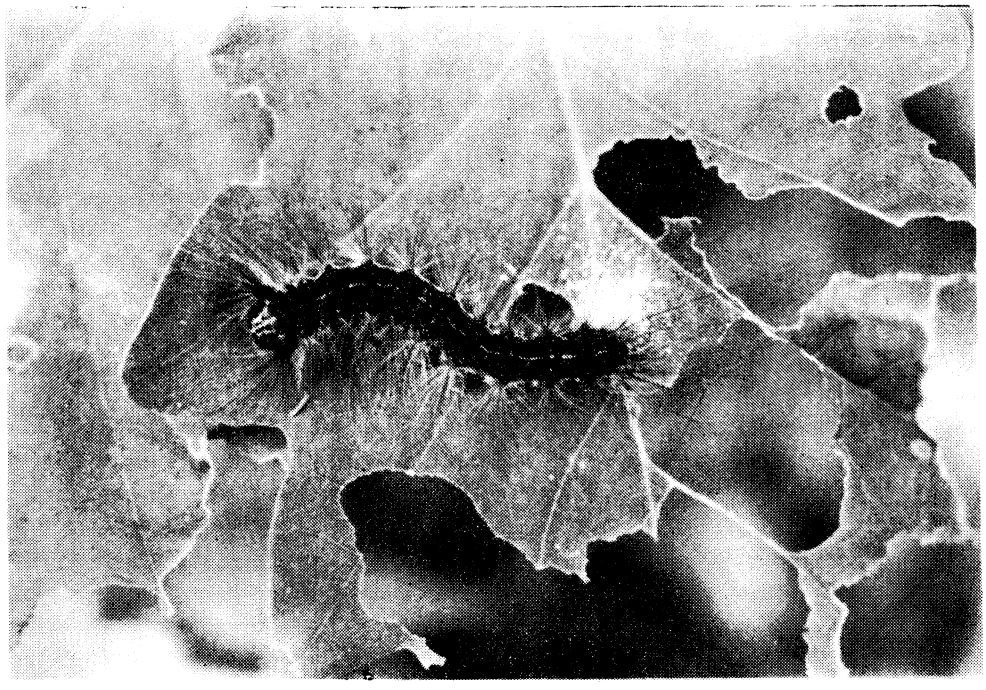
Second highest 1 hour average concentration - 96 ppb (100 ppb in 1989)

Bennington:

Highest 1 hour average concentration - 114 ppb (106 in 1989)

Second highest 1 hour average concentration - 107 ppb (101 in 1989)

Figure 2. Fifth instar gypsy moth larva.



Although areas with high egg mass counts remain, populations have collapsed or failed to develop in much of the region. The fungal pathogen, *Entomophaga maimaiga*, is thought to be responsible for bringing the outbreak to a premature end over a large area. This fungus was introduced to the Boston area from Japan in 1910-1911 and began acting as a natural control last year in northeastern areas with above normal precipitation. With an even greater increase in precipitation this year, the fungus was even more widespread, with confirmation of its occurrence further north in the state (Milton) than in 1989. There was also an abundance of virus-killed gypsy moth larvae in many locations this year, making it difficult to determine which was the most prevalent mortality factor.

Heavy larval mortality was seen, beginning the third week of June. Larvae which survived often had thin or incomplete pupal cases. Mortality of females was apparently heaviest. Female moths were scarce in areas with many males, whose flight lasted longer than usual. Individual moths were seen flying as late as September.

Several areas in the Connecticut River Valley in Orange County that had high egg mass counts in the fall of 1989 apparently suffered winter mortality of egg masses above snowline, and 1990 defoliation was only light. Many surviving larvae were infected by fungus and virus.

Gypsy moth populations for 1991 are generally lower than in 1989 but are increasing in some northern locations, as reflected by the focal area monitoring data (Table 4).

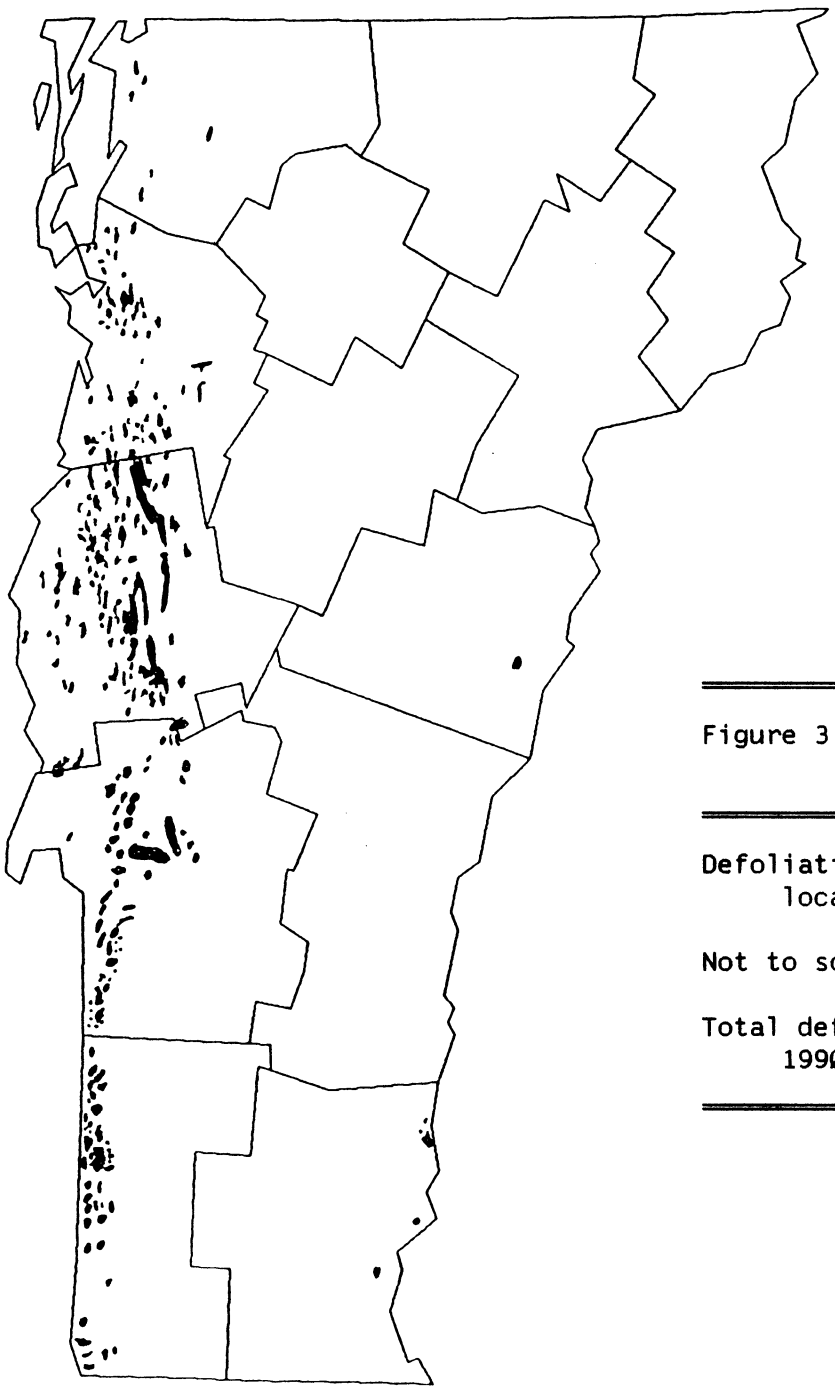


Figure 3. 1990 Gypsy Moth Defoliation.

Defoliation area approximate location.

Not to scale.

Total defoliation mapped in 1990 = 61,270 acres.

Defoliation is expected in scattered locations in 1991. Addison and Chittenden Counties are expected to experience some defoliation in 1991, but it is likely to be much less widespread and less severe than in 1990. Surveys in Bennington and Rutland Counties indicate that populations are variable even within a single town. Egg masses are robust in some locations, but small and poorly formed in others. Counts made to date range from less than 100 to over 7000 per acre.

Table 3. Mapped acres of defoliation by gypsy moth in 1990.

	Damage Level			
County	Light (< 30%)	Moderate (30-60%)	Heavy (>60%)	Total Acres
Addison	510	6,190	5,070	11,770
Bennington	-	5,600	16,900	22,500
Chittenden	450	870	400	1,720
Franklin	-	30	50	80
Orange	-	100	100	200
Rutland	-	5,900	17,700	23,600
Windham	-	400	1,000	1,400
Total	960	19,090	41,220	61,270

Table 4. Gypsy moth counts from focal area monitoring plots 1986-1990.[1, 2]

Plot	# of Egg Masses				
Location	1986	1987	1988	1989	1990
Minards Pond	0	0	7	99	10
Fort Dummer	2	0	1	1	0
Handley Mountain	1	1	4	417	7
Perch Pond	0	115	226	168	1
Rocky Pond	0	6	53	>400	11
Petersburg	1	0	1	296	89
Tate Hill	0	0	6	498	5
Arrowhead[3]	5	21	48	96	3
Brigham Hill[4]	10	37	28	74	212
Middlesex	0	0	1	19	23
Sandbar	-	45	173	226	57
Average	2	20	46	200	38

1. Total number in 15m diameter burlap-banded plots.
2. Average of 2 or 3 plots in 1986 and 2 plots in 1987-1990.
3. Aerial sprayed with B.t. (Foray) in 1990.
4. Aerial sprayed with B.t. (SAN415) in 1988.

A cooperative gypsy moth suppression project was conducted in late May to protect foliage on 7,734 acres in Chittenden County and 3,503 acres in Addison County, for a total of 11,237 acres. This was a cooperative effort between our department, the Vermont Department of Agriculture, and the U.S. Forest Service. The latter agency also provided 50 percent cost reimbursement. Most of the acreage in Addison County (3,202 ac.) was at the request of the Green Mountain National Forest and most of the acreage in Chittenden County (7,514 ac.) was at the request of the following municipalities: Burlington, South Burlington, Colchester, Essex (town and village), and Winooski.

All spray blocks were treated once with Foray 48B (*Bacillus thuringiensis* var. *kurstaki*), applied by small, twin-engine, fixed-wing aircraft at the rate of 24 Billion International Units (64 oz.) per acre. Spray operations were carried out by Duflo Spray Chemical Inc. out of Burlington International Airport. (Figure 4). Larvae were at optimum development size (46% instar 1; 51% instar 2; 3% instar 3) for the Foray to be effective, but noticeable defoliation (average of 9%) had already taken place prior to treatment. Foliage expansion at time of treatment averaged about 80 percent. Weather conditions on the days of spraying were excellent and no rain was received for at least 30 hours after treatment.

To evaluate defoliation, 10 to 30 oak trees per block were rated from the ground for 26 of the Chittenden County blocks. This was done on the day of treatment to estimate prespray defoliation, and again in mid-July to estimate final defoliation. This was compared to data from 30 trees per block for five unsprayed blocks in the same general area. Prespray (1989) egg mass counts taken in the fall of 1989 to determine spray blocks were based on a combination of five minute walk egg mass counts and one-fortieth acre plots, while postspray (1990) counts were based on 194 fixed-area plots, mostly one-fortieth acre in size, distributed among 62 spray blocks and six untreated check blocks.

Some moderate to heavy defoliation (about 3% of the area) took place in some spray blocks, but overall, the project was very successful. Defoliation in the town project spray blocks averaged 12 percent compared to 52 percent in the unsprayed areas (Figure 5). Some oaks suffered considerable defoliation by first and second instar larvae just prior to treatment (Figure 6). Defoliation on the days of spraying averaged nine percent. Thus, on average, only three percent additional defoliation took place after treatment. Postspray egg mass counts averaged 299 per acre for Chittenden County spray blocks compared to prespray counts of 5,136 per acre (Figure 7). Untreated areas (5 in Chittenden County and 1 in Addison County) averaged 2,761 postspray (1990) egg masses per acre compared to 4,057 prespray (1989) egg masses per acre. Addison County spray blocks, excluding the Green Mountain National Forest, averaged 155 postspray egg masses per acre compared to 2,418 prespray egg masses per acre. Only three spray blocks, totaling 212 acres, have high enough egg mass counts (more than 1,000 per acre) to potentially result in moderate to heavy defoliation in 1991.

Figure 4. Aztec spray planes being prepared for gypsy moth spray operations: 5/27/90.

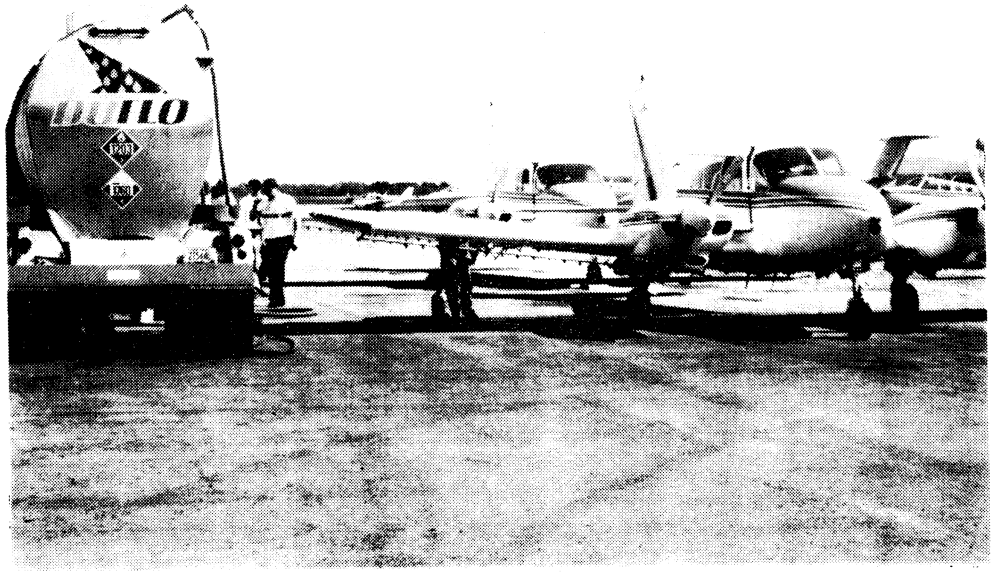
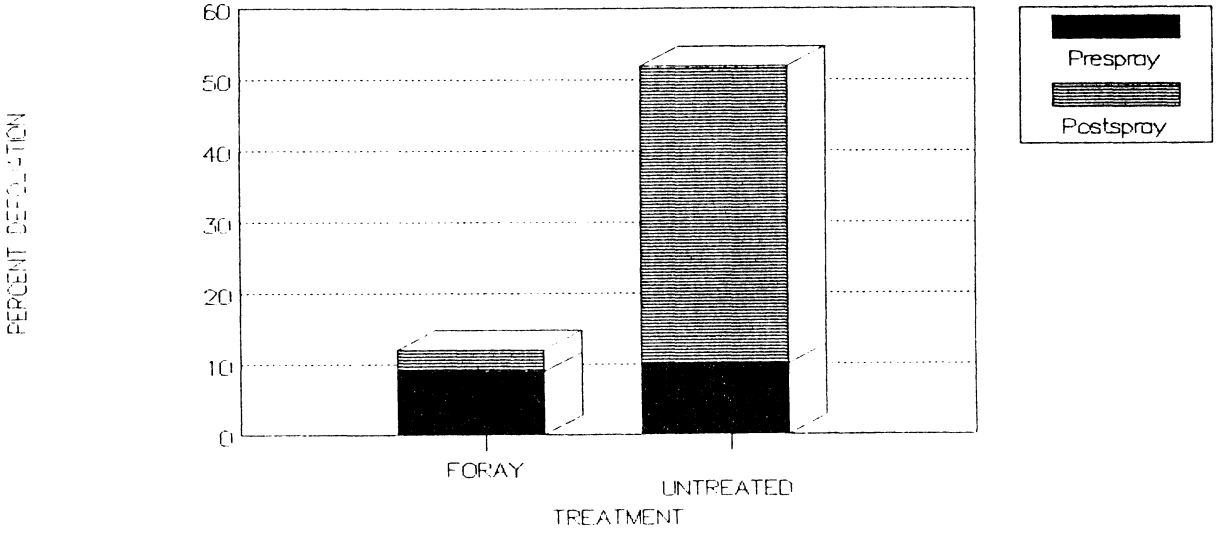


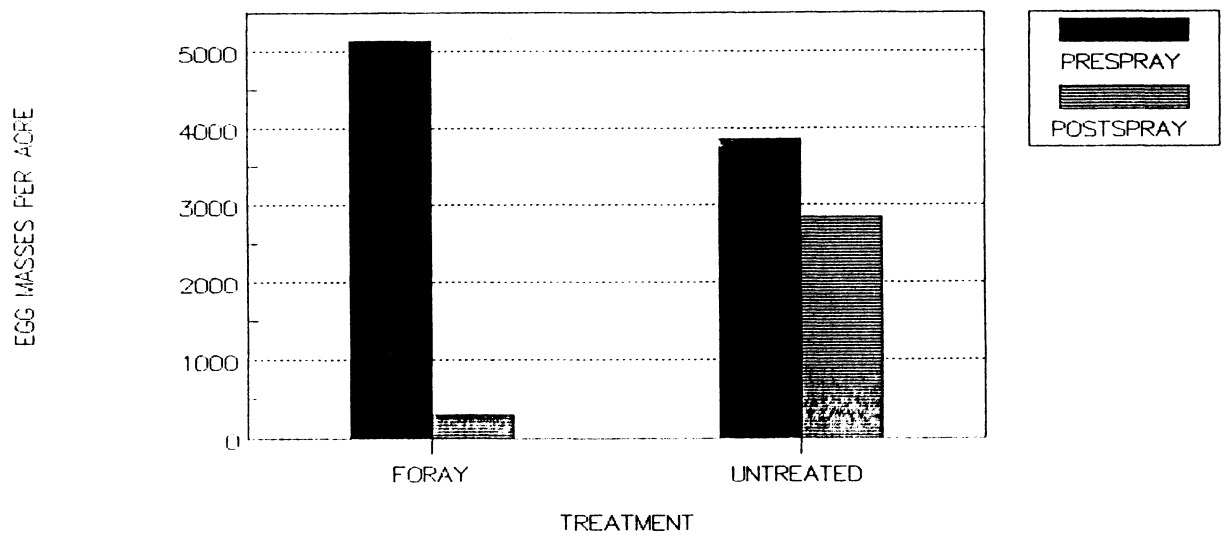
Figure 5. Average gypsy moth defoliation in 25 treated[1] and 5 untreated Chittenden County blocks.



1. Treated with Foray in 1990.

Figure 6. Heavy defoliation of young oak leaves by 1st and 2nd instar gypsy moth larvae.

Figure 7. Average gypsy moth pre-spray (fall 1989) and post-spray (fall 1990) egg mass counts in 39 treated[1] and 5 untreated Chittenden County blocks.



1. Treated with Foray in May 1990.

Maple Leaf Cutter, *Paraclemensia acerifoliella*, populations increased substantially with widespread light defoliation evident by early September, plus scattered areas of heavy defoliation. Heavy damage was mostly confined to lower and inner (next to trunk) crowns of sugar maple making aerial detection extremely difficult. This defoliation pattern is typical of other years when rainy periods coincided with adult emergence, concentrating egg laying in more protected areas of the crown.

Heavy defoliation was detected from the air on 460 acres in northern Vermont, with an additional 140 acres of heavy defoliation detected in Franklin County (Richford) by a ground visit.

In Southern Vermont, heavy populations of maple leaf cutter, together with anthracnose, pear thrips, and maple trumpet skeletonizer, contributed to widespread browning of foliage that was mapped on 3100 acres, including a number of sugarbushes (Table 5, Figure 8).

Table 5. Acres of maple browning mapped in August.

County	Maple Leaf Cutter	Anthracnose	Complex[1]
Caledonia	130	1060	
Essex	60	300	
Franklin	140	40	
Orleans	270	580	
Rutland			110
Windham			130
Windsor			2850
Total	600	1980	3090

Total Browning Mapped = 5670 acres

1. Agents responsible include maple leaf cutter, anthracnose, maple trumpet skeletonizer, and pear thrips.

One 23 acre sugarbush in Hartford was aerially sprayed with Dipel 8AF at 16 b.i.u.s per acre. Insect counts were made before and after the application to monitor efficacy. Two 4-leaf cluster samples were taken from the mid-lower crown of ten codominant trees. The number of live larvae per leaf dropped by half from 1.9 pre-spray to 0.9 post-spray (Table 6). Foliage protection was difficult to evaluate because of anthracnose. In general, foliage from the upper crown had only anthracnose damage, while foliage in the lower crown had moderate damage from maple leaf cutter.

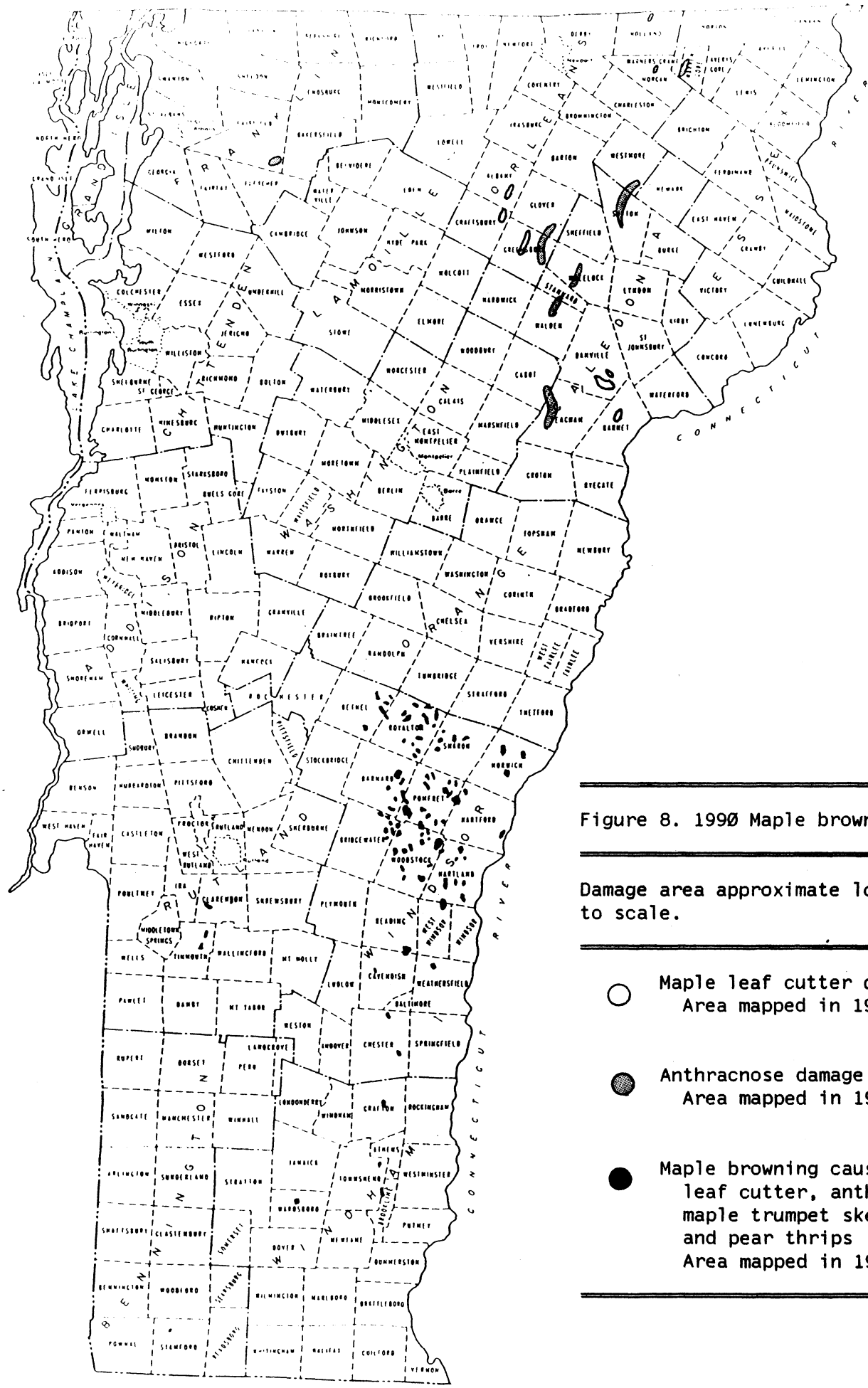


Figure 8. 1990 Maple browning.

Damage area approximate location. Not to scale.

○ Maple leaf cutter damage
Area mapped in 1990=600 acres

Anthracnose damage
Area mapped in 1990=1980 acres

● Maple browning caused by maple leaf cutter, anthracnose, maple trumpet skeletonizer and pear thrips
Area mapped in 1990=3090 acres

Table 6. Average counts of maple leaf cutter larvae and damage before and after aerial spraying with Bt on 7/6/90.

	Pre-Spray (6/19)	Post-Spray (7/18)	
# Live Larvae/Leaf	1.8	0.9	p=.01
# Dead Larvae/Leaf	0.2	0.8	p=.01
Average % of Larvae Dead	10%	42%	p=.01
# of Cuts/Leaf	2.2	2.5	n.s.

Oak Leaf Tier, *Croesia semipurpurana*, was not observed causing any damage. However, moths were collected this year in pheromone traps (Table 7).

Table 7. Oak leaf tier in pheromone traps 1988-1990.

	# of Moths/Trap*		
Location	1988	1989	1990
Brattleboro	40	0	1.3
Brigham Hill	-	-	0.3
Rockingham	60	0	1.3
Rupert	-	0	0
Sandbar	-	-	0

* Average of three traps, except Rockingham in 1988.

Saddled Prominent, *Heterocampa guttivata*, populations increased, with 2,780 acres of defoliation mapped from the air (Table 8, Figure 9). Larval activity was heavy in scattered locations throughout Southern Vermont, although much of the defoliation was confined to upper crowns. Pupae could be found in several locations in Orange County this fall so this insect has the potential to increase in 1991. Elsewhere very few pupae have been found in the soil, even in areas which had high larval populations. It is expected that a fungal pathogen is responsible for the collapse.

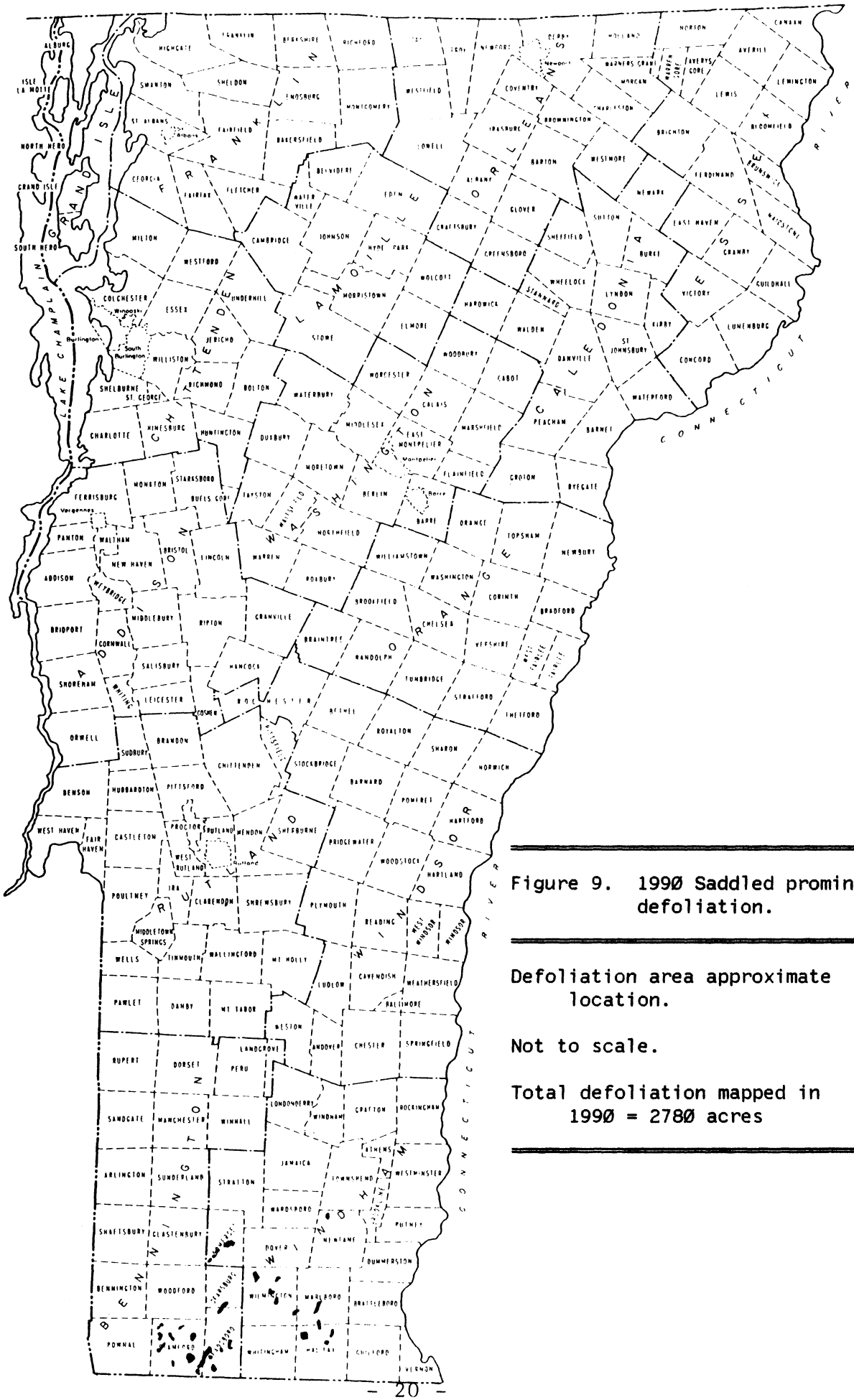


Figure 9. 1990 Saddled prominent defoliation.

Defoliation area approximate location.

Not to scale.

Total defoliation mapped in 1990 = 2780 acres

Table 8. Mapped acreage of defoliation by saddled prominent.

County	Acres Mapped
Bennington	153Ø
Windham	125Ø
Total	278Ø

Satin Moth, *Leucoma salicis*, caused heavy damage to poplars and willows in early June. Damage was observed in widely scattered locations in southern and central Vermont. Cottonwoods in riparian areas were most commonly defoliated. In northern Vermont, satin moth was less common than 1989.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
American Aspen Beetle *Gonioctena americana*			Not observed.
American Dagger Moth *Acronicta americana*			Not observed.
Birch Leaf Folder *Ancylis discigerana*	Yellow Birch	Hyde Park	Trace damage only.
Birch Leaf Miner *Fenusa pusilla*	Paper Birch Grey Birch Yellow Birch	Widespread 21Ø acres aerially mapped in Franklin & Chittenden Counties	Unusually little defoliation from first generation probably due to wet weather during egg laying; some moderate to heavy defoliation from second generation feeding.
Birch Skeletonizer *Bucculatrix canadensisella*	White Birch Yellow Birch		Not observed.

OTHER HARDWOOD DEFOLIATIORS

INSECT	HOST(S)	LOCALITY	REMARKS
Bruce Spanworm *Operophtera bruceata*	Sugar Maple	Hartland	Moderate defoliation in a sugarbush. Associated with pear thrips. Moths observed in November in Bristol, Peacham and Stowe.
Cecropia Moth *Hyalophora cecropia*	Crab Apple	Morristown	Unusually heavy infestation on ornamental, but only light defoliation.
Cherry Scallop Shell Moth *Hydria prunivorata*			See narrative.
Dogwood Sawfly *Macremphytus tarsatus*	Silky Dogwood	Bristol Middlebury	Light defoliation of ornamentals.
Early Birch Leaf Edgeminer *Messa nana*			Not observed.
Eastern Tent Caterpillar *Malacosoma americanum*	Cherry Apple	Widespread	Common but decreased from 1988-89 levels.
Elm Leaf Beatle *Pyrrhalta luteola*	American Elm	Scattered	Very light defoliation.
Elm Leaf Miner *Fenusa ulmi*			Not observed.
Euonymus Caterpillar *Yponomeuta multipunctella*	Euonymus	Springfield	Ornamental.
European Snout Weevil *Phyllobius oblongus*	Walnut	Rockingham	Ornamental.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Fall Cankerworm *Alsophila pometaria*			Not observed.
Fall Webworm *Hyphantrea cunea*	Hardwoods	Widespread except Northeast Kingdom	More noticeable than during the past few years. Observed on cherries and apples in forest situations.
Forest Tent Caterpillar *Malacosoma disstria*			See narrative.
Green Striped Mapleworm *Anisota rubicunda*	Maples		Not observed.
Gypsy Moth *Lymantria dispar*			See narrative.
Half Winged Geometer *Phigalia titea*			Not observed.
Japanese Beetle *Popillia japonica*	Ornamentals	Widespread	Light but increasing compared to 1989. Damage to ornamentals associated with turf damage on one golf course.
Large Aspen Tortrix *Choristoneura conflictana*			Not observed.
Linden Looper *Erranis tiliaria*			Not observed.
Locust Leaf Miner *Odontata dorsalis*	Black Locust	Chittenden Washington Counties	Some moderate to heavy defoliation.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Maple Leaf Cutter *Paraclemensia acerifoliella*			See narrative.
Maple Leafblotch Miner *Cameraria aceriella*	Sugar Maple Red Maple	Chittenden Franklin	Light damage, first year that this miner has been very noticeable.
Maple Petiole Borer *Caulocampus acericaulis*	Sugar Maple	Weston	Forest situation.
Maple Trumpet Skeletonizer *Epinotia aceriella*	Sugar Maple Red Maple	Widespread	Very heavy in scattered locations, particularly Windsor County. Common elsewhere. See Maple Leaf Cutter.
Maple Webworm *Tetralopha asperatella*	Sugar Maple	Northern Vermont	Common this year for the first time in several years; light defoliation.
Mountain Ash Sawfly *Pristophora genicultata*	Mountain Ash	Caledonia County	Decreased this year; detected in only one area.
Oak Leafroller *Archips semiferanus*			Not observed.
Oak Leaf Tier *Croesia semipurpurana*			See narrative.
Oak Skeletonizer *Bucculatrix ainsliella*	Oak	Bennington & Windham Counties	Light damage where gypsy moth populations had collapsed.
Orange-humped Mapleworm *Symmerista leucitys*			Not observed.

OTHER HARDWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Pear Sawfly *Caliroa cerasi*	Hawthorne	Danville	Remains present.
	Cherry	Ludlow	Ornamental.
Pin Oak Sawfly *Caliroa sp.*			Not observed.
Red-humped Oakworm *Symmerista canicosta*			Not observed.
Rose Chafer *Macrodactylus subspinosus*	Hardwood Ornamentals	St. Johnsbury	Decreasing but noticeable.
Saddled Prominent *Heterocampa guttivata*			See narrative.
Satin Moth *Leucoma salicis*			See narrative.
Solitary Leaf Roller *Sparganothis pettitana*	Sugar Maple	Lamoille County	Scattered, light.
		Rutland County	Associated with maple leaf cutter.
Solitary Oak Leaf Miner *Cameraria hamadryadella*			Not observed.
Spiny Elm Caterpillar *Nymphalis antiopa*			Not observed.
Spring Cankerworm *Paleacrita vernata*			Not observed.
Uglynest Caterpillar *Archips cerasivoranus*	Cherry	Widely scattered	Occasionally observed.

Softwood Defoliators

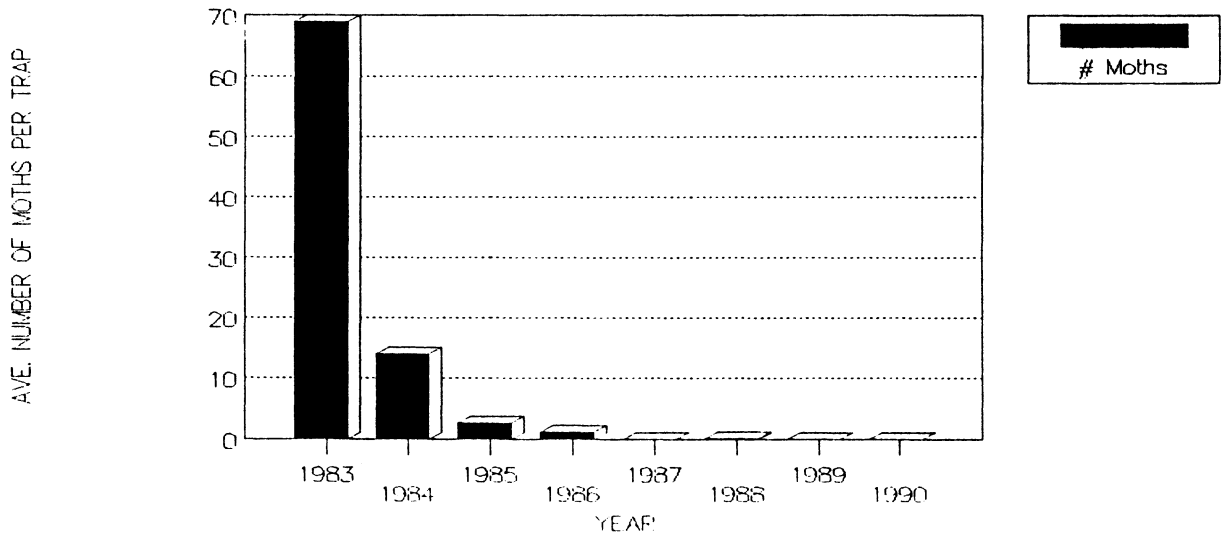
Hemlock Looper, *Lambdina sp.*, is responsible for defoliating approximately 10 acres of hemlock in Vernon and Brattleboro. Defoliation was first observed in July. Needle loss was more severe in the older foliage of upper crowns, however, some trees were completely brown by November. Branch samples were analyzed by the Maine Forest Service. In Vernon, an average of 2.7 eggs per 100 cm of branch predicts that 65% of previous years' needles and 20% of current needles will be defoliated in 1991. Eggs of *L. fiscellaria* were not found on the Brattleboro samples, suggesting that defolation there was caused by *L. athasaria*.

Larch Casebearer, *Coleophora laricella*, is increasing in northern Vermont, but caused less widespread damage this year in southern Vermont. However, 250 acres of tamarack in Rutland County (Clarendon) and 100 acres in Bennington County (Bennington and Dorset) were defoliated.

Spruce Budworm, *Choristoneura fumiferana*, continued at extremely low levels in 1990, with no visible defoliation and no larvae detected. Only one budworm moth was caught in pheromone traps again this year.

Pheromone traps have been used in the state ever since 1983, the last year of heavy budworm defoliation, and moth catch reflects the dramatic drop in population levels since then (Figure 10).

Figure 10. Annual average number of spruce budworm moths caught per trap: 1983-1990.



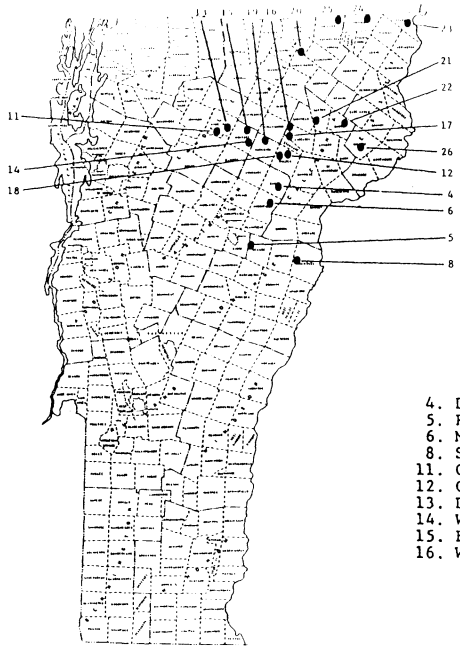
For the past three years, 20 sites have received three Multi-pher traps per site (Table 9). Only one trap from a different location (Figure 11) each year (Sutton (1988); Newbury (1989); Wheelock (1990)) has caught any moths, indicating that moth catch is probably a random event and there are no apparent "hot spots" or "focal areas" for spruce budworm. All traps were baited with "Biolures" this year and this is expected to be the standard lure from now on.

Table 9. Average number of spruce budworm moths caught per trap in pheromone traps, 1987-1990.[1]

Lure	1987	1988	1989	1990
PVC	0.01	0.05	0.00	--
Biolure	--	--	0.03	0.02
Number of Sites	19	20	10 per lure	20

1. Multi-pher traps: 3 per site in 1990, 1989, and 1988; 3-5 per site in 1987.

Figure 11. Spruce budworm pheromone plot locations.



4. Danville Hill
5. Reservoir
6. Marshfield Pd.
8. Scotch Hollow
11. Centerville
12. Coles Pd.
13. Diggins
14. Wolcott F&G
15. Bear Swamp
16. Withers
17. Mason
18. Star School
19. Beagle Club
20. Brownington P
21. Calendar Brk.
22. Chieppo
23. Bunnel Brk.
24. Norton Cem.
25. Holland Pd.
26. Victory Bog

OTHER SOFTWOOD DEFOLIATORS

INSECT	HOST(S)	LOCALITY	REMARKS
Arborvitae Leaf Miner *Argyresthia thuiella*	Arborvitae	Widespread	Ornamentals; increasing in northern Vermont with abundant light defoliation and some moderate defoliation.
Balsam Fir Sawfly *Neodiprion abietis*			Common in 1989 for the first time, but not observed in 1990.
European Pine Sawfly *Neodiprion sertifer*	Scots Pine	Weathersfield	Christmas trees.
Green Hemlock Needleminer *Coleotechnites apicitripunctella*			Not observed.
Hemlock Looper *Lambdina fiscellaria*	Hemlock		See narrative.
Introduced Pine Sawfly *Diprion similis*	Scots Pine	Hubbardton	Numerous enough on Christmas trees to require control.
	White Pine	Windsor County	Observed occasionally.
Larch Casebearer *Coleophora laricella*			See narrative.
Larch Sawfly *Pristophora erichosonii*			Not observed.
Pine False Webworm *Acantholyda erythrocephala*			Common in 1989, but not observed this year.
Pine Webworm *Tetralopha robustella*			Not observed.

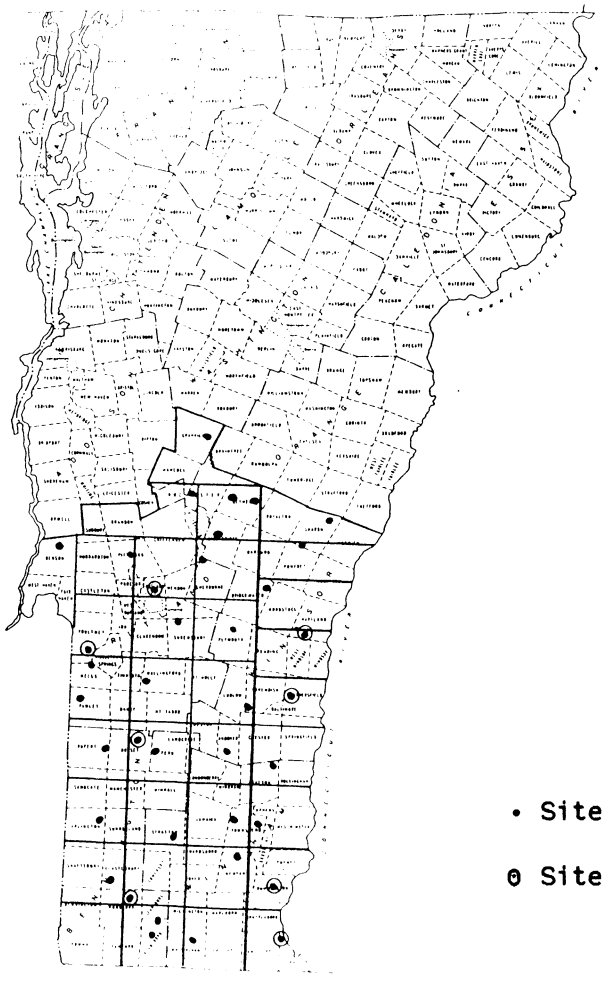
OTHER SOFTWOOD DEFOLIATORS

INSECTS	HOST(S)	LOCALITY	REMARKS
Red-Headed Pine Sawfly *Neodiprion lecontei*			Not observed.
Spruce Bud Moth *Zeiraphera canadensis*	White Spruce	Walden Waterville	Moderate infestations in two Christmas tree plantations; increasing.
Spruce Budworm *Choristoneura fumiferana*			See narrative.
Spruce Coneworm *Dioryctria reniculleloides*	White Spruce Fraser Fir	Rutland	Light damage to Christmas trees.
Spruce Webspinning Sawfly *Cephalacia fascipennis*	White Spruce	Sharon	Isolated nest in Christmas trees.
White Pine Sawfly *Neodiprion pinetum*			Not observed.
Yellow-headed Spruce Sawfly *Pikonema alaskensis*	White Spruce Red Spruce Blue Spruce	Waterville Danville St. Johnsbury Randolph	More reports than in 1989. The Randolph plantation that suffered heavy damage in 1988 had only a few larvae early in the season; population here collapsed. Increasing elsewhere.

The chance for eradicating the infestation is good. The planting site is at a high elevation, where native hemlock does not occur in the surrounding forestland. Additional scouting surveys will be done in 1991 in and around the planting area.

To continue monitoring the state for other possible infestations, a subsample of the 1989 systematic survey plots was reexamined for hemlock woolly adelgid. Eight of the thirty-eight original plots were revisited. No adelgids were detected (Figure 12).

Figure 12. Location of hemlock woolly adelgid survey sites.



Oystershell Scale, *Lepidosaphes ulmi*, caused noticeable damage to beech in a forested area in Wilmington mapped during aerial surveys. Elsewhere, it is causing little damage, but beech dieback associated with recent past infestations remains noticeable. An evaluation of scale population levels within Camel's Hump State Forest showed an increase in number of insects this year after reaching a low in 1989 (Table 11).

Table 11. Number of oystershell scales on current year twigs in Camel's Hump State Forest, 1987-1990.[1]

Tree Dominance	Average Number of Mature Viable Scales Per: Twig				Millimeter			
	1987	1988	1989	1990	1987	1988	1989	1990
Suppressed	3.7	3.4	1.7	2.1	0.10	0.22	0.05	0.05
Intermediate	6.8	2.8	1.0	8.5	0.07	0.12	0.01	0.13
Codominant	9.3	8.8	3.7	7.4	0.27	0.64	0.09	0.11

1. Average for 10 branches from one tree per dominance class, collected in September 1988, November 1989 and October 1990.

Pear Thrips, *Taeniothrips inconsequens*, damage to sugar maples increased in 1990, with 29,760 acres mapped, compared to 3,170 acres in 1989. (Table 12, Figures 13 and 14). This is still considerably less than the 1988 damage (469,000 acres). Most of the defoliation mapped from the air was moderate to heavy. This remains a conservative figure since many areas throughout the state received light damage which was difficult to detect against the delayed green-up of late-flushing species.

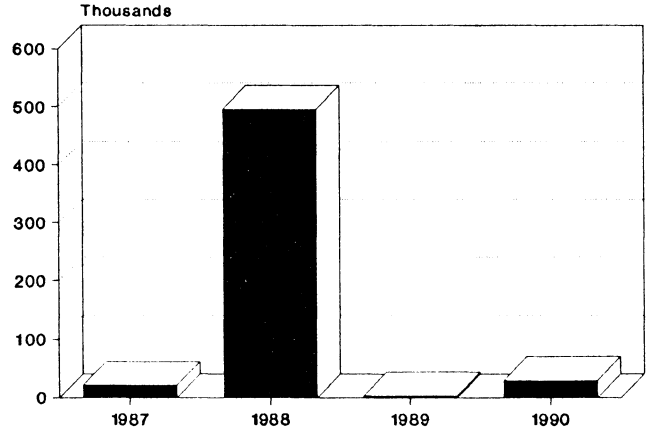
The majority of the damage occurred in Lamoille, Orange, and Washington counties. Damage was negligible in most of Bennington, Rutland and Windham Counties where green-up occurred very quickly in late April. More widespread (mostly moderate) damage occurred where green-up at mid- to upper- elevations was delayed due to a long cold period in early May.

Refoliation of sugar maple was well underway the week of June 18. Refoliation was highly variable this year, even within stands. Some trees refoliated quickly while others refoliated partially or not at all. Complete refoliation usually occurred where individual trees were heavily damaged. However, many moderately damaged maple stands and sugarbushes did not refoliate. Thin crowns and brown leaves from thrips damage became more visible as the season progressed. Many of the sugar maples attacked by thrips early in the season were further damaged by anthracnose, maple leaf cutter, maple webworm, and/or maple trumpet skeletonizer later on. The cumulative effect resulted in moderate defoliation for many trees that were near the upper end of the light category (i.e. 20-30% defoliation) for thrips damage.

Table 12. Mapped acres of damage by pear thrips, 1987-1990.

County	Acres Damaged			
	1987	1988	1989	1990
Addison	---	6,100	400	670
Bennington	14,460	179,200	---	---
Caledonia	---	5,400	150	---
Chittenden	---	3,050	870	1,300
Essex	---	---	---	---
Franklin/Grand Isle	---	100	140	200
Lamoille	---	250	680	8,990
Orange	---	8,900	---	4,150
Orleans	---	900	---	---
Rutland	4,400	143,100	---	120
Washington	---	14,700	930	11,080
Windham	2,690	69,000	---	3,250
Windsor	250	38,300	---	---
Total	21,800	469,000	3,170	29,760

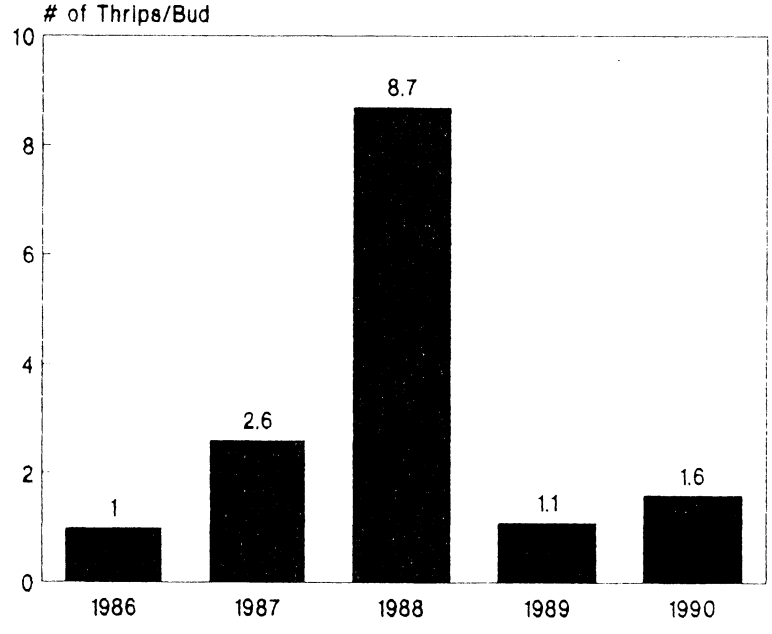
Figure 13. Mapped acres (in thousands) of damage by pear thrips, 1987-1990.



In addition to sugar maple, damage to American beech, red oaks and black cherry was observed. One stand in Camel's Hump State Forest had American beech overstory trees with upper crown damage severe enough to cause refoliation. In red oak, the damage was associated with anthracnose. Black cherry damage resulted in normal-looking leaves being dropped from the tree.

Spring bud counts in southern Vermont indicated a population increase from 1989. (Figure 15A).

Figure 15A. Average thrips counts in buds of sugar maple in southern Vermont 1986-1990.[1]



1. Average of 2 sugarbushes in 1986 and 6 sugarbushes in 1987-1990 (100 buds/ sugarbush).

Results are available from the 1989 test of Sevin 4 0:1 (carbaryl) to control pear thrips on sugar maples. Two timings were used: first emergence of pear thrips from the soil, and peak emergence, when 50% of the insects had emerged from the soil. Emergence traps were used to monitor emergence of thrips from the soil in the spring. Efficacy was determined using pre-and post-spray counts of thrips in buds from 5 sprayed sites per timing and 4 check sites per timing. Spray application was made using a fixed wing aircraft. An equal mix of pesticide and deodorized kerosene was applied at 64 oz. per acre.

Although carbaryl was effective in reducing thrips populations in some plots, this was not a repeatable treatment (Figure 15B) and is not recommended as a management tool. Any improvements in the understanding of bud development as it relates to thrips numbers in buds may change how we approach the complex issue of controlling this pest in the future. Some of this information is being obtained from additional data collected during the study.

Soil sampling was continued in September 1990 at the same sites sampled in 1988 and 1989. This is the third year in the study to determine if known populations of thrips in the soil can be correlated to severity of damage the following spring. Populations were generally low throughout the state compared to previous years. Soil sampling results from the first two years, and subsequent acres defoliated are found in Table 13.

Table 13. Average number of live pear thrips adults in soil samples prior to spring emergence and subsequent acres of damage mapped during aerial surveys.

	Fall/Winter 88-89	Spring '89	Fall '89	Spring '90
County	Avg. # of Live Thrips/Sample[1]	Acres Damaged	Avg. # of Live Thrips/Sample[1]	Acres Damaged
Addison	4.5	400	14.3	670
Bennington	2.9	0	5.2	0
Caledonia	2.5	150	5.7	0
Chittenden	11.9	870	12.2	1,300
Essex	0.5	0	1.6	0
Franklin	12.3}	140	18.1}	200
Grand Isle	-- }		4.0}	
Lamoille	15.5	680	7.1	8,990
Orange	4.6	0	3.3	4,150
Orleans	6.9	0	3.7	0
Rutland	1.5	0	2.1	120
Washington	8.4	930	6.3	11,080
Windham	3.0	0	6.9	3,250
Windsor	4.6	0	7.8	0

1. A sample is approximately 16 $in.^3$, taken with a bulb planter.

Pine Bark Adelgid, *Pineus strobi*, was unusually heavy on white pine in scattered locations throughout the state. Most commonly affected were ornamentals and overstocked forest trees. In some areas, severe chlorosis of 1989 needles occurred early in the season associated with this insect.

Spruce Spider Mite, *Oligonychus ununguis*, damage, from 1989 feeding, was seen in widely scattered southern Vermont locations. Spruce and fir Christmas trees had damage early in the season. In general, infested plantations had more hatched eggs than current eggs, indicating declining populations probably due to frequent heavy rainfall. Scattered light damage, from 1990 feeding, was observed on hemlock and spruce.

OTHER SAPSUCKING INSECTS, MIDGES & MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Aphids *Periphyllus sp.*	Sugar Maple	Brandon	Numerous, with heavy honeydew, on ornamentals which are routinely sprayed with carbaryl.
Aphids *Cinara sp.*	Balsam Fir White Pine Blue Spruce	Orleans and Lamoille Counties. Brattleboro	Damaging 60 acres of Christmas trees. Heavy on ornamentals.
Balsam Gall Midge *Paradiplosis tumifex*			See narrative.
Balsam Twig Aphid *Mindarus abietinus*			See narrative.
Balsam Woolly Adelgid *Adelges piceae*			Not observed.
Beech Scale *Cryptococcus fagisuga*	Beech		See Beech Bark Disease.
Birch Budgall Mite *Aceria rudis*			Not observed.
Cottony Maple Scale *Pulvinaria innumerabilis*			Not observed.
Eastern Spruce Gall Adelgid *Adelges abietis*	Red Spruce White Spruce	Widespread	Increasing; 82 acres of mostly moderate heavy damage to white spruce Christmas trees compared to 36 acres of light damage in 1989.
Hemlock Woolly Adelgid *Adelges tsugae*			See narrative.

OTHER SAPSUCKING INSECTS, MIDGES & MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Lacebugs *Corythuca sp.*	American Elm Balsam Poplar	Washington Orange Chittenden Counties	Decreasing, but damage noticeable along roads and streams.
Leafhoppers	Sugar Maple Misc. Hardwood	Widespread	Light damage noticeable.
Leaf Stem Gall Aphid *Phylloxera caryaecaulis*	Hickory	Springfield	Ornamentals.
Lecanium Scale *Lecanium sp.*			Not detected; was common in 1988.
Maple Spindle Gall Mites *Vasates aceris-crumena*	Sugar Maple	Widespread	Remains common.
Oystershell Scale *Lepidosaphes ulmi*			See narrative.
Pear Thrips *Taeniothrips inconsequens*			See narrative.
Pine Bark Adelgid *Pineus strobi*			See narrative.
Pine Leaf Adelgid *Pineus pinifoliae*			Not observed.
Pine Needle Midge *Contarinea baeri*			Not observed.
Pine Needle Scale *Chionapsis pinifoliae*	Mugho Pine	Morrisville	Trace levels.

OTHER SAPSUCKING INSECTS, MIDGES & MITES

INSECT	HOST(S)	LOCALITY	REMARKS
Pine Spittlebug *Aphrophora parallela*	Scots Pine White Pine Red Pine	Throughout	180 acres of Christmas trees reported as infested. Moderate shoot damage from 1989 feeding observed in Putney.
Pine Thrips *Gnophothrips sp.*			Not observed.
Pine Tortoise Scale *Toumeyella parvicornis*			Not observed.
Root Aphid *Prociphilus americanus*	Balsam Fir	East Montpelier Albany	Present, but at low population levels.
Spruce Bud Scale *Physokermes piceae*			Not observed.
Spruce Spider Mite *Oligonychus ununguis*			See narrative.
Treehoppers *Membracidae*			Not observed.
Woolly Alder Aphid *Prociphilus tessellatus*			Not observed.
Woolly Apple Aphid *Eriosoma lanigerum*			Not observed.

BUD, SHOOT, AND STEM INSECTS

The Balsam Shootboring Sawfly, *Pleroneura brunneicornis*, continued its past trend of heaviest populations in even years. This year damage was detected in 373 acres of balsam and Fraser fir in northern Vermont, of which 213 acres were moderate to heavy. This compares to 48 acres of light to moderate damage in 1989. Some information from Maine Forest Service entomologists indicates that the adult sawflies may be laying eggs long before bud break. This would explain why we have not observed any adults in Vermont at or just before bud break when balsam twig aphid surveys are conducted.

White Pine Weevil, *Pissodes strobi*, continued to cause widespread terminal shoot mortality in conifers. Dimilin was tested on white pine by Christmas tree growers in Whitingham and Shrewsbury, in cooperation with the Maine Forest Service. In both plantations, 100% control was achieved. In the Whitingham site, 6% of the leaders had been damaged in 1989, and wild trees adjacent to the treated area were damaged by weevil in 1990. In the Shrewsbury site, additional Scots pines were treated with lindane. The lindane-treated trees also received no weevil damage.

OTHER BUD, SHOOT AND STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Allegheny Mound Ant *Formica exsectoides*	Scots Pine Douglas-Fir White Spruce	Cornwall Athens	Some mortality in Christmas tree plantation.
Ambrosia Beetle *Scolytidae*	Paper Birch	Groton	Light damage.
Balsam Shootboring Sawfly *Pleroneura brunneicornis*			See narrative.
Black Walnut Curculio *Conotrachelus retentus*	English Walnut	Rockingham	Persistent infestation in small orchard.
Butternut Curculio *Conotrachelus juglandis*			Not observed.
Coneworm *Dioryctria sp.*			Not observed.
Horned Oak Gall *Callirhytis cornigera*	Red Oak	Barnard	Regeneration.

OTHER BUD, SHOOT AND STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Locust Borer *Megacyllene robiniae*			Not observed.
Northern Pine Weevil *Pissodes approximatus*			Not observed.
Pales Weevil *Hylobius pales*	Scots Pine	Widespread	Damage to Christmas trees similar to 1989, 170 acres of light to moderate damage reported.
Pine Gall Weevil *Podapion gallicola*			Not observed.
Pine Root Collar Weevil *Hylobius radicis*	Scots Pine	Cornwall	Causing about 5% mortality of 3'-5' tall Christmas trees.
Pitted Ambrosia Beetle *Corthylus punctatissimus*	Sugar Maple Seedlings	Addison Chittenden Franklin Caledonia Orleans Counties	Present but decreasing compared to 1989.
Poplar Gall Saperda *Saperda inornata*	Quaking Aspen	Dummerston	Heavy infestation of 10'-12' regeneration in aspen clearcut.
Pseudanthonomus validus			Not observed.
Round-headed Apple Tree Borer *Saperda candida*	Apple Mountain Ash	Danville Reading Victory Weston	Ornamentals.
Sugar Maple Borer *Glycobius speciosus*	Sugar Maple	Cavendish Bridgewater	Sugarbush. Many old injuries in sawtimber stand.
Twig Pruner *Elaphidionoides villosus*			Not observed.

OTHER BUD, SHOOT & STEM INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
White Pine Weevil *Pissodes strobi*			See narrative.
White Spotted Sawyer *Monochamus scutellatus*			Not observed.
Zimmerman Pine Moth *Dioryctria zimmermanni*	Scots Pine	Springfield	Heavy damage to ornamentals.

BARK BEETLES

INSECT	HOST(S)	LOCALITY	REMARKS
Bronze Birch Borer *Agrilus anxius*	White Birch	Springfield	Recent transplants.
Eastern Larch Beetle *Dendroctonus simplex*	Eastern Larch	Widespread	Decreasing; no new areas of larch decline detected this year compared to 46 acres in 1989 and 646 acres in 1988.
Elm Bark Beetles *Hylurgopinus rufipes* *Scolytus multistriatus*	American Elm	Widespread	See Dutch Elm Disease.
Pine Engraver *Ips pini*	White Pine	Southern Vermont	Associated with decline and mortality on wet sites and where planted too deep.
Red Turpentine Beetle *Dendroctonus valens*	White Pine	Jamaica Springfield	Associated with white pine blister rust or recent cutting.
White Pine Bark Miner *Marmara fasciella*	White Pine	Athens	Associated with mortality of suppressed regeneration.

ROOT INSECTS

INSECT	HOST(S)	LOCALITY	REMARKS
Conifer Swift Moth *Korsheltellus gracilis*	Balsam Fir Red Spruce	Northern Vermont	Associated with feeding wounds at high elevations.
Broad Necked Root Borer *Prionus laticollis*	Oak	Springfield	Ornamentals.

FOREST DISEASES

Stem Diseases

Beech Bark Disease, caused by *Cryptococcus fagisuga* and *Nectria coccinea* var. *faginata*, became noticeable enough this year that 1,690 acres of damage was mapped in the Northeast Kingdom during the annual aerial survey (Table 14, Figure 16). This is the first time in many years that mortality and decline has been heavy enough to detect from the air. Scattered yellow crowns of infected beech trees were more evident than usual by mid to late summer in the Central part of the state. Although this disease complex appeared to be on the increase in recent years in northern Vermont, the disease remains steady at low levels in southern Vermont monitoring plots (Figure 17).

Table 14. Mapped acres of 1990 beech decline and mortality due to beech bark disease.

County	Acres
Caledonia	740
Essex	700
Orleans	250
Total	1,690

Scleroderris Canker, caused by *Ascocalyx abietina*, was not found in any new locations for the fourth consecutive year. A total of 53 Christmas tree plantations within the quarantine zone (Figure 18), and 92 red and Scots pine plantations in 18 towns bordering the quarantine area, were surveyed for the presence of the disease, all with negative results. The disease does not appear to be spreading outside of previously infected plantations, and within infested plantations the rate of spread remains slow.

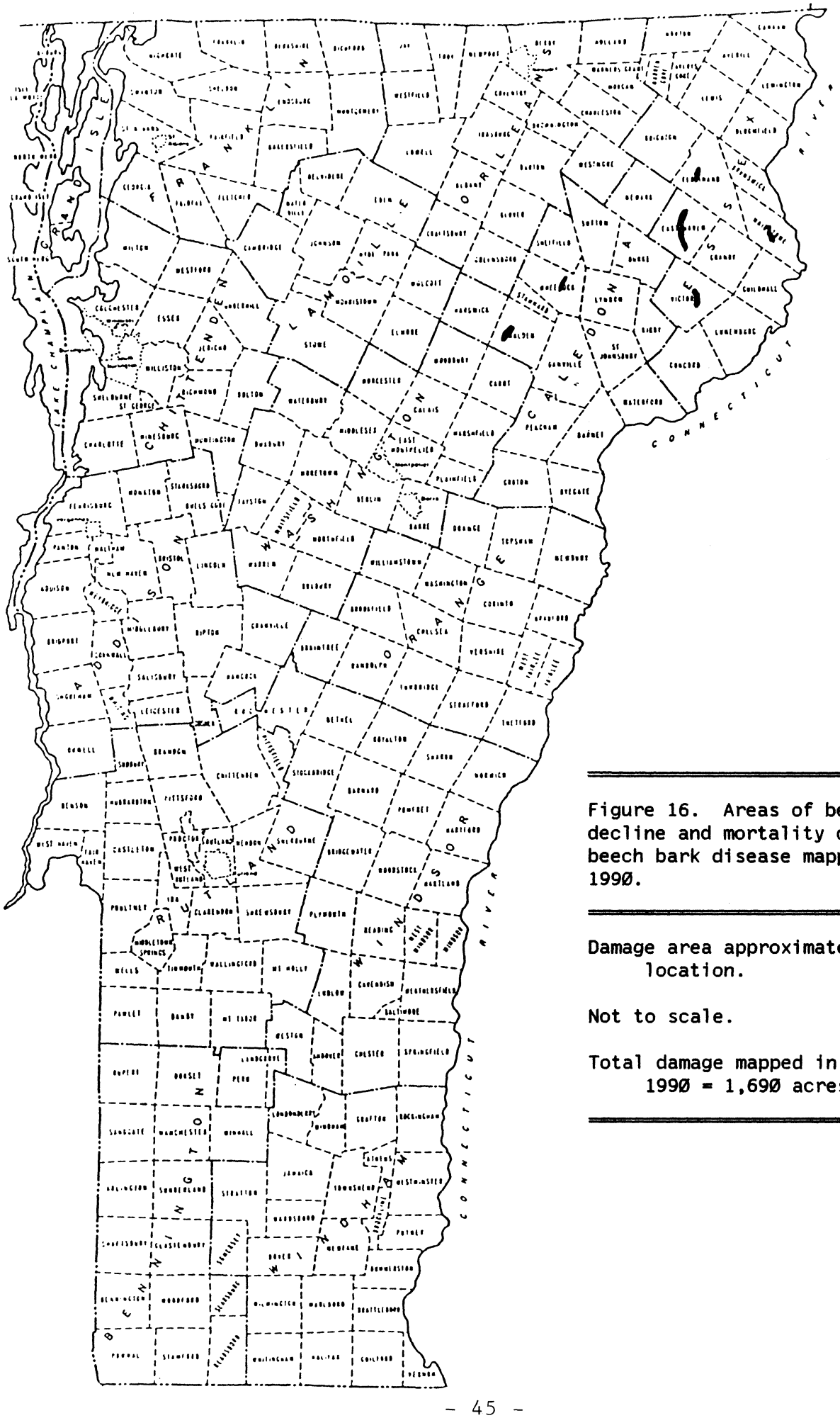


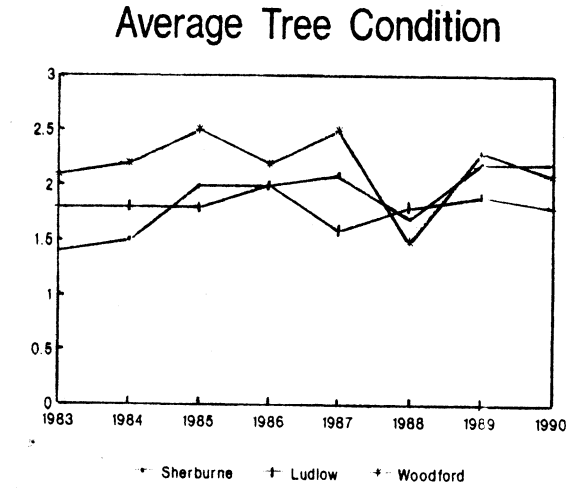
Figure 16. Areas of beech decline and mortality due to beech bark disease mapped in 1990.

Damage area approximate location.

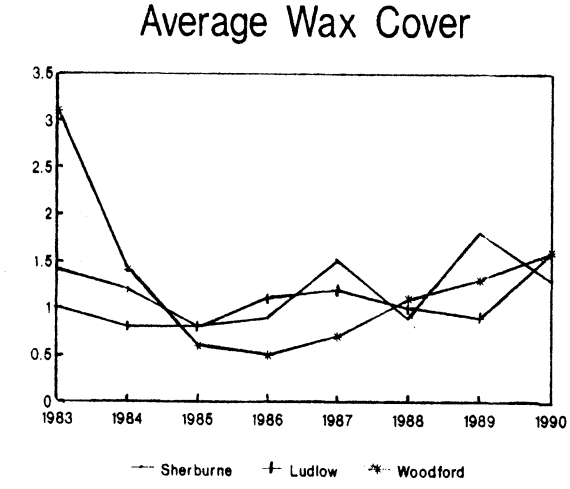
Not to scale.

Total damage mapped in 1990 = 1,690 acres.

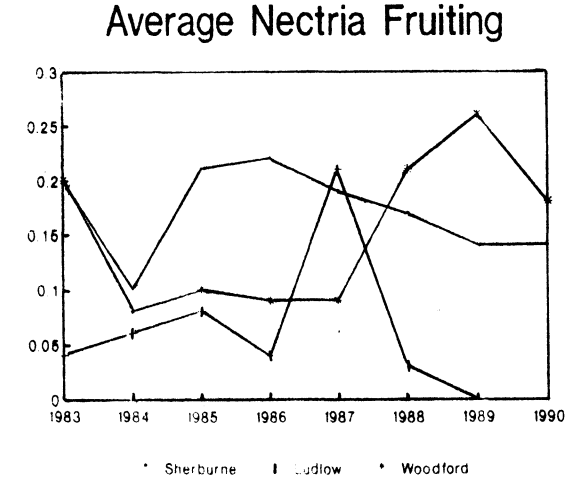
Figure 17. Summary of beech bark disease monitoring plots 1983-1990.



1 Good, 2 Fair, 3 Poor, 4 Dead



0 None,1 Trace,2 Light,3 Mod,4 Heavy



0 None, 1 Sparce, 2 Moderate

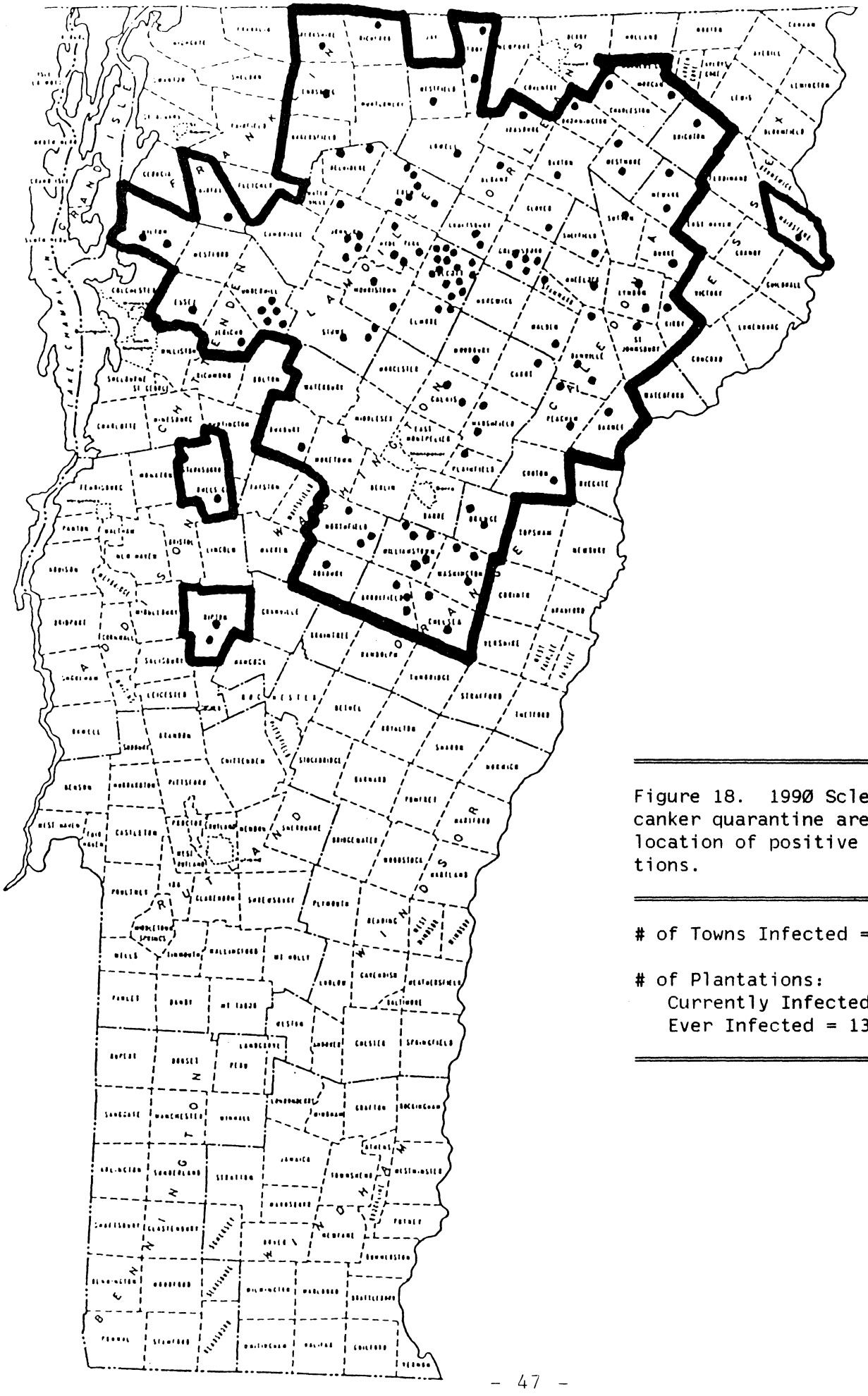


Figure 18. 1990 Scleroderris canker quarantine area and location of positive infections.

# of Towns Infected = 64

# of Plantations:
Currently Infected = 124
Ever Infected = 130

There are still 124 plantations (992 acres) in the state known to be infected, consisting of 106 red pine (842 acres) and 18 Scots pine plantations (150 acres). Another six plantations were infected at one time, but have since had the disease eradicated or the trees cut. Some recent infection can be found within most of the quarantine zone.

White Pine Blister Rust, caused by *Cronartium ribicola*, continues to cause some mortality, particularly of Christmas trees, ornamentals and regeneration. Damage was reported for 291 acres of Christmas trees in northern Vermont compared to 111 acres in 1989. Most of the damage was light, but 88 acres were moderately damaged. Blister rust was causing mortality in a pole-sized stand in Westminster. Elsewhere, damage in forest stands is common, but stable.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Annual Canker *Fusarium sp.*			Not observed.
Balsam Fir Twig Abnormality *Sclerotinia kerneri*	Balsam Fir	Mt. Holly	Causing dieback.
Beech Bark Disease *Cryptococcus fagisuga* and *Nectria coccinea* var. *faginata*			See narrative.
Black Knot *Dibotryon morbosum*	Cherry	Widespread	Remains common.
Butternut Canker *Sirococcus clavigignenta-juglandacearum*	Butternut		No new reports.
Caliciopsis Canker *Caliciopsis pinea*	White Pine	Throughout	Associated with overstocked or off-site trees.
Canker Rot *Cerrena unicolor*	Sugar Maple	Woodstock	Associated with sudden mortality of a shade tree stressed by drought and a girdling root.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Chestnut Blight *Cryphonectria parasitica*	Chestnut	Monkton	Several roadside trees affected.
Cytospora Canker *Cytospora kunzei*	Blue Spruce	Widespread	Past damage still evident. Less common than other years.
Diplodia Shoot Blight *Sphaeropsis sapinea*	Red Pine	Reading	Scattered through a 15 year old plantation.
		Bristol	Heavy damage to ornamental.
Dutch Elm Disease *Ceratocystis ulmi*	American Elm	Throughout	Flagging common by late June.
Eastern Dwarf Mistletoe *Melampsorella caryophyllacearum*			Not observed.
Fireblight *Erwinia amylovora*	Mountain Ash Apple Pear Cherry	Widely scattered	Increasing; numerous homeowner calls in St. Johnsbury area.
Hypoxylon Canker *Hypoxylon pruinatum*	Quaking Aspen	Throughout	Remains common; trees frequently break off at canker during heavy snow and ice storms.
Maple Canker *Steganosporium sp.* *Nectria sp.*			Not observed; was somewhat common in 1989 and abundant in 1988.
Oak Wilt *Ceratocystis fagacearum*	Oaks		No suspects seen by trained observers during aerial flights.
Sapstreak *Ceratocystis coerulescens*	Sugar Maple	Guilford Bethel	Staining seen associated with mortality in recently thinned stands.

OTHER STEM DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Scleroderris Canker *Gremmeniella abietina*			See narrative.
Sirococcus Shoot Blight *Sirococcus strobilinus*	Red Pine		No new sites.
Smoth Patch *Dendrothele macrodens*	Ash	Woodstock Barnard	Slow-growing trees.
Verticillium Wilt *Verticillium albo-atrum* or *V. dahliae*	Sugar Maple	St. Johnsbury	One ornamental maple affected.
White Pine Blister Rust *Cronartium ribicola*			See narrative.
Woodgate Gall Rust *Endrocronartium harknessii*	Scots Pine	Northern Vermont	Noticeably more abundant this year; caused mostly moderate damage to 200 acres of Christmas trees compared to 97 acres of mostly light to moderate damage in 1989.

Foliage Diseases

Anthracnose was widespread in the state this year. Most symptoms showed up following the cool, wet weather in May, or following a rainy period in mid-August. High levels of anthracnose in 1989 left plenty of fungus inoculum to take advantage of wet conditions.

Maple Anthracnose, caused by *Gloeosporium sp.*, caused scattered browning earlier in the season, especially in Windham County. Damage was much more extensive in mid-August. Anthracnose damage was mapped on 1980 acres in the Northeast Kingdom and Franklin County. An additional 3090 acres of browning were mapped in southern Vermont, caused by anthracnose and several insects. (See Maple Leaf Cutter, Table 5, Figure 8).

Oak Anthracnose, caused by *Apiognomonia quercina*, was widespread in southern Vermont, with symptoms showing up in early June. Most of the damage observed was in the Connecticut valley. Damage was irregular, with scattered trees being completely browned, while neighbors were browned at the top only or not at all. Symptomatic trees refoliated by mid-July.

Sycamore Anthracnose, caused by *Apiognomonia venata*, was unusually severe. Complete defoliation and scattered shoot mortality were widespread particularly in Bennington and Windham Counties. Refoliation began by mid-June, but sycamores remained tufted throughout the season.

Other anthracnose diseases seen in 1990 included *Gloeosporium betulae-luteae* on yellow birch in Bennington County and *Gnomoniella carpina* on hophornbeam in Windsor County.

Lophodermium Needlecast, caused by *Lophodermium pinastri*, caused heavy damage to Scots pine Christmas trees in scattered locations. In two plantations, where needlecast was associated with winterburn, damage was so severe that some trees were culled. In northern Vermont, this disease is less common than Cyclaneusma. Lophodermium was also seen causing premature needlecast on white pine in Woodstock.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Anthracnose *Gloeosporium* spp.			See narrative.
Apple Scab *Venturia inequalis*	Apple Mountain Ash	Norwich Chester Westminster	Ornamentals.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Bulls Eye Spot *Cristulariella moricola*	Boxelder Norway Maple	Norwich Windsor	Not affecting adjacent sugar maples.
Cyclaneusma Needlecast (formerly Naemacyclus) *Cyclaneusma minus*	Scots Pine	Throughout	Increasingly common; reported as a problem in 427 acres of Christmas trees compared to 68 acres in 1989. Causing heavy needle loss in half of the plantations.
European Larch Needlecast *Mycosphaerella laricina*			Not observed.
Juniper Blight *Cercospora sequoiae-juniperi* *Phomopsis juniperovona*		Chester Ludlow Hartford	Damage to nursery and landscape shrubs.
Lophodermium Needlecast *Lophodermium pinastri*			See narrative.
Poplar Leaf Bronzing Virus or virus-like causal agent	Balsam Poplar	Caledonia Orleans Counties	Remains common, but not as noticeable this year.
Powdery Mildew *Microsphaera syringae*	Lilac	Norwich	Heavy infection.
Rhabdocline Needlecast *Rhabdocline pseudotsugae*	Douglas Fir	Waterbury Springfield	Remains present, causing some heavy needle loss. Down from previous years.
Rhizosphaera Needlecast *Rhizosphaera kalkhoffi*	Blue Spruce White Spruce	Widespread	Increasingly common on Christmas trees and ornamentals.

OTHER FOLIAGE DISEASES

DISEASE	HOST(S)	LOCALITY	REMARKS
Septoria Leaf Spot *Septoria mussiva*	Balsam Poplar	Southern Vermont	Heavy defoliation widespread in mid August. Some refoliation.
Swiss Needlecast *Phaeocryptopus gaumani*	Douglas Fir	Brookfield Cornwall Brattleboro Springfield	Heavy damage to some Christmas tree plantations.
Stigminia sp.	No. White Cedar	Concord	Smothering lower foliage of heavily mulched ornamentals.
Tar Spot *Rhytisma acerinum*	Red Maple Sugar Maple	Throughout	Common this year.
Willow Scab *Venturia saliciperda*	Willow	Southern Vermont	Heavy defoliation, widespread, especially in Clarendon.

ROOT ROTS

DISEASE	HOST(S)	LOCALITY	REMARKS
Annosus Root Rot *Heterobasidion annosum*	Red Pine	Guilford	Several infection centers in an overstocked stand.
	White Pine	Weathersfield	Causing widespread butt rot in a sawtimber stand.
Brown Root Butt Rot *Phaeolus schweinitzii*	White Pine	Wallingford	Causing butt rot in healthy, understocked white pine.
	Red Spruce	Weston	Causing pockets of windthrow on a wet site.
Shoestring Root Rot *Armillaria mellea*	Norway Spruce	Woodstock	Occasional dieback and mortality.
	Balsam Fir	Shrewsbury	Scattered individuals.
	White Pine	Castleton	Mortality in one clump of trees.
	White Spruce	Washington	Causing mortality.

DIEBACKS DECLINES & ENVIRONMENTAL DISEASES

ASH DIEBACK remains common especially where the basal area of white ash is substantial (i.e., 30% or more). Ash yellows, a mycoplasma-like organism, is widespread in lower elevation sites, especially abandoned farm lands.

BIRCH DECLINE and scattered mortality remains noticeable in scattered locations, particularly in north-central Vermont and high elevations in Windsor County. Dieback may be associated with past birch leaf miner defoliation in some areas. Generally, symptoms are improving. Low levels of birch leaf miner in recent years have reduced the stress on birch.

DROUGHT conditions in 1988 continue to cause losses, particularly among landscape trees. Ornamental maples with girdling roots, sugarbushes on shallow sites, and trees disturbed by grade changes or wounding developed new dieback or died in 1990. Drought effects are known to persist for several years following a dry year.

EDEMA symptoms were seen on the needles of balsam fir Christmas trees growing on wet sites in Bennington and Springfield. Edema develops in response to waterlogged soil conditions. Symptomatic needles have swellings similar to lenticels on lower surfaces. The wet spring of 1989 is thought to be responsible for the symptoms, which were first observed during winter 1989-90.

FROST INJURY was observed on maples at higher elevations in Mendon, Sherburne, Rupert, and Sunderland. Balsam fir Christmas trees in Windham had light damage. Many needles were constricted in the middle, where young tissue was weakened by cold temperature. Later on, needles with heavier damage broke at the constriction.

HERBICIDE INJURY was seen in several locations. Roundup injured Douglas fir Christmas trees in two plantations, causing pockets of mortality. Dicamba injured ornamental spruce on a golf course. Ronstar injured a variety of species in a small nursery. Princep is thought to be the cause of chlorosis in a white spruce Christmas tree plantation.

IMPROPER PLANTING continues to be a source of dieback and mortality. In some cases, symptoms have only recently shown up on trees that were transplanted several years ago. Again, it is suspected that the dry conditions two years ago contributed to the decline. Among the situations encountered were white spruce Christmas trees, town street trees, and ornamentals planted too deep. The scattered occurrence of mortality and dieback associated with girdling roots suggests that more careful planting in the past would have increased longevity.

LARCH DECLINE was observed in Rutland County in stands that have had mortality in the past. Recent defoliation by larch casebearer is probably responsible for the decline. Elsewhere, decline associated with past outbreaks of the eastern larch beetle has largely subsided, although older dead trees are still noticeable. No new areas of larch decline were detected by aerial survey this year for the first time in many years. Ample rainfall during the past two years has probably been a major factor in this change. In 1988, 646 acres of new larch decline were detected, and this dropped to 46 acres in 1989.

MAPLE DECLINE continues to be a concern. Monitoring continued in plots established as part of the North American Sugar Maple Decline Project.

In general, maples continued to appear healthier than normal except for areas of moderate to heavy thrips defoliation. Two consecutive years of plentiful rainfall and limited defoliation contributed to dense, green leaves. Maple foliage generally stayed green a little later into the autumn than usual, with very little early leaf color noticeable this year.

Dieback and mortality occur in forest stands and sugarbushes where stresses have occurred. Hygrading left an unthrifty stand of trees in Newfane, where dieback is high. In a sugarbush in Bethel, a shallow site, past overtapping, and thrips defoliation contributed to scattered mortality. In a Guilford sugarbush, overtapping and sapstreak from logging injuries led to mortality as well. Street trees and ornamentals continue to be in poor condition due to drought, poor site, wounding, and improper planting.

PHYSIOLOGICAL CONDITIONS are thought to be the cause of premature shedding of last year's green needles from white spruce at budbreak. Symptoms occurred on Christmas trees in scattered locations. Affected trees were often genetically related. Similar symptoms were seen several years ago in New Brunswick.

SNOW DAMAGE from an early winter storm that began on 10 November caused unusually heavy limb and tree breakage throughout most of northern Vermont, except for the Connecticut River Valley and Champlain Valley areas. Heavy winds following the storm continued to blow down trees, and many residences were without electrical power for up to a week. Pine, hemlock, and balsam fir had particularly heavy damage, including 15 acres of red pine (Howe Block) on state land in Waitsfield (estimated 20% loss).

WET FEET was the cause of chlorosis and mortality in white pine stands, which occurred on scattered wet sites throughout southern Vermont. Pine engravers were often seen on recently dead trees. Mortality, chlorosis, and frost heaving also occurred to white spruce Christmas trees planted on a wet site in 1989. Several years of above average rainfall contributed to the wet conditions.

WHITE PINE NEEDLE BLIGHT was largely absent for the third consecutive year. Only a few scattered white pines in Orange and Washington Counties were observed to have some symptoms of this malady on current year needles.

WINTERBURN symptoms were widespread, brought on by cold December temperatures when trees had not fully hardened off. This was followed by warm weather in January. Christmas tree plantations were particularly hard hit. Scots pine, white spruce, balsam fir, white pine and fraser fir were among the species affected. Of the pine Christmas tree plantations inspected in northern Vermont, nearly half of them (337 acres) had some winter injury. Moderate to heavy damage was reported for 234 acres, most of which was Scots Pine. Although new growth developed as normal, some short-needled Scots pine were culled, especially where Lophodermium needlecast occurred as well.

FOREST HEALTH PROGRAMS

The **North American Maple Project** (NAMP) began in 1988 as a result of general concern over the condition of sugar maple trees in Vermont, as well as the entire U. S. and Canada. This project is an attempt to determine how maple forests change over time, given different initial stand decline conditions and different levels of air pollution. It is meant to be long-term, so that when there are changes in tree condition, we will be prepared to answer why these changes have occurred.

In Vermont, 29 plots (Figure 19) have been established where annual information is being gathered on tree health, occurrences of potential stressors, management activities and site characteristics. Information on sugarbush and non-sugarbush plots is compared. Regional air quality information is also compared to tree conditions.

Trends in the condition of sugar maple trees summarized from the NAMP program in 1988 and 1989 are:

- There was less dieback observed in 1989 than in 1988 both in tapped and untapped maple stands.
- Crown foliage was less dense in 1989 than in 1988 in both tapped and untapped maple stands.
- No trends were found between the level of air pollution and tree condition, as assessed by the amount of branch dieback and the density of crown foliage.
- Untapped maple stands tended to have less dieback than maple trees that were tapped for syrup production, although in both types of stands trees were generally healthy.

A new report on the status of forests in Vermont is forthcoming in 1991, and will include more details on this and other forest health programs.

The **New England Forest Health Monitoring Program** was initiated in 1990 to monitor the health of all tree species in the forests of New England. It is a joint, long-term program between the six New England states and the U. S. Forest Service, with some assistance from the U. S. Environmental Protection Agency. The first year was devoted to characterizing the initial condition of forests and their potential stressors. In the future we will measure changes in forests, and attempt to relate these changes to forest stressors. This is the only way we feel we can understand what factor or factors cause forest declines, and therefore prevent further declines from occurring.

Thirty-five of the 263 plots in this program are located in Vermont (Figure 19). Annual and periodic information will be gathered. Results from the New England plots will first be published in a statistical report by the Forest Service, then results from Vermont plots will be reviewed in a report on the status of Vermont's forests.

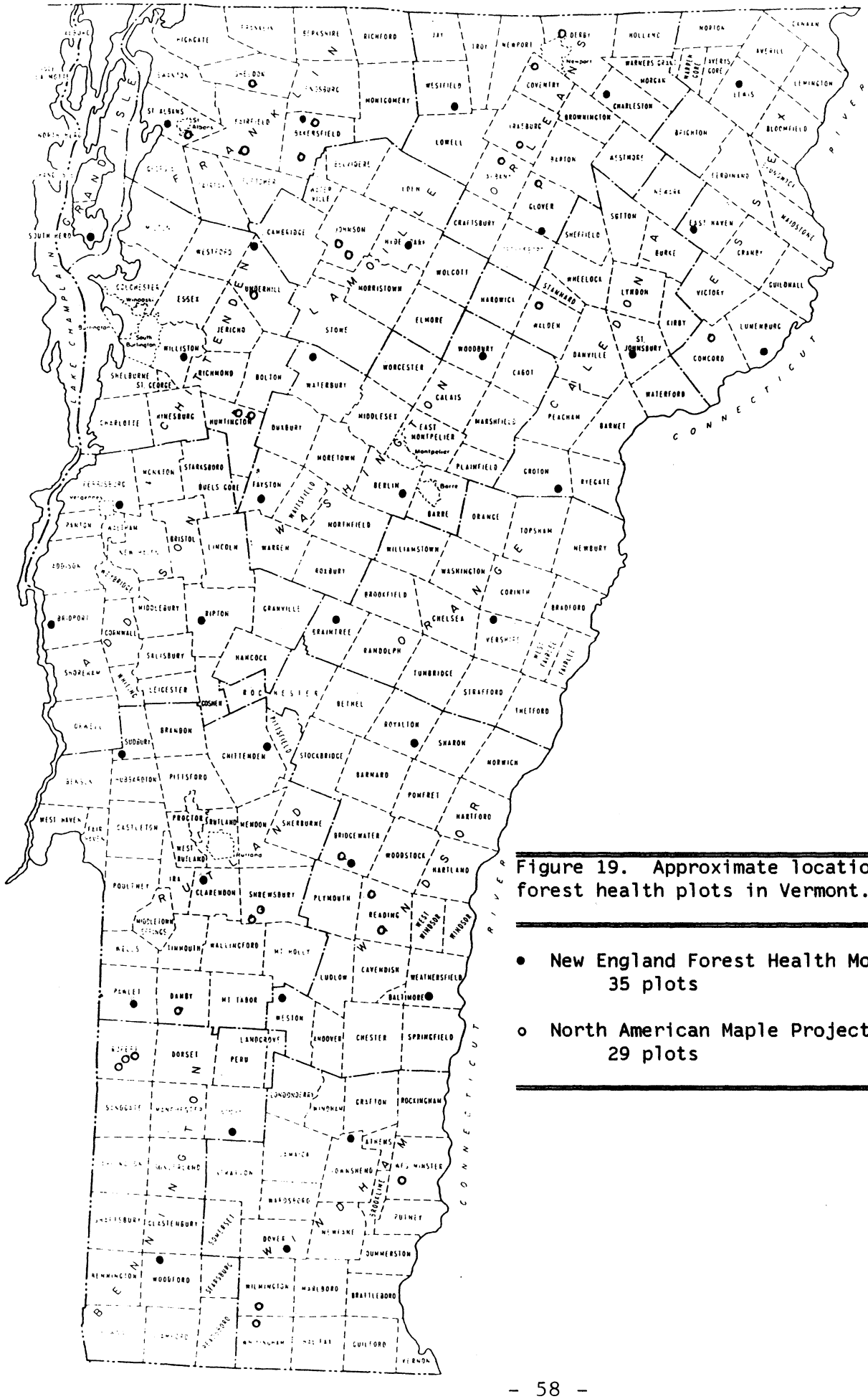


Figure 19. Approximate location of forest health plots in Vermont.

- New England Forest Health Monitoring
  35 plots

- North American Maple Project
  29 plots

The **Vermont Hardwood Health Survey** done in 1985-86 is being repeated in 1990-91. The survey was initiated to determine the current health of Vermont hardwood forests and to monitor changes in the health status, and determine the effects of stress on hardwoods in the state. In the 1985-86 survey, 170 photo points were rated with color-infrared photography. Additional information was obtained on 75 ground plots.

The U. S. Forest Service re-photographed plots in 1990 and is completing photo-interpretation this winter. Ground plots will be reevaluated in 1991.

The **Vermont Monitoring Cooperative** is a joint project between state agencies, the University of Vermont and the U. S. Forest Service, which has the following objectives: to identify the conditions, trends and relationships occurring in a forested ecosystem; to coordinate monitoring activities at one site; and to provide any resulting information to forest managers. Monitoring activities will be focused on one site, the Mt. Mansfield/Proctor Maple Research Center area in Underhill. A work plan is presently being written to include measurement of tree conditions, weather, air quality, animal species and others.

Presently, information on Vermont's forest environment is being gathered by state personnel in forestry, air pollution control, water quality, health, fish and wildlife, and agriculture, but never at the same place, during the same time period, with the goal of integrating the information. This cooperative should allow for a much more coordinated program, to give us a more complete picture of our forest environment.

The **Take-a-Plot** program has completed its third year. Landowners in ten counties are sending in data. Of the plots that have been monitored since 1988, one-half have improved over the three year period, based on percent of overstory trees with no more than 10% dieback. Tree condition in fifteen percent of the plots has declined.